THE TIP OF THE TONGUE STATE
INDUCED BY MUSICAL STIMULI

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CONTENTS

LIST OF FIGURES

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

The purpose of this study was to examine the phenomenon of knowing that a melody is familiar but being unable to name it. The occurrence and nature of such a "Tip of the Tongue" (TOT) state induced by musical stimuli was investigated by translating Brown and McNeill's (1966) procedure and findings to a musical setting. Transformations of familiar melodies were used as the stimuli. Twenty musically inexperienced and musically experienced subjects were required to perform seven tasks which tested the occurrence of a TOT state and the type of information available. A TOT state occurred with both types of subjects and a range of information was available. Subjects possessed knowledge of the rhythm of the melody, later parts of the melody and the category of the melody. A surprising and unique finding was that a systematic progression of occurrence of recalled information existed. This is a possible line of investigation for future research.

CHAPTER I

INTRODUCTION

The Tip of the Tongue phenomenon is the frustrating experience of not quite recalling a familiar word but nonetheless being convinced that retrieval is imminent. It is a familiar experience in everyday life. The term was coined to describe experimental investigations of this curious state that were first conducted by Brown and McNeill in 1966. Observations of the Tip of the Tongue, or "TOT" state have tended to be based on personal experience and are thus unsystematic. When describing the TOT state to another person, the experience is instantly recognized because of its common occurrence and associated feelings of frustration.

Research since the middle of the 1960s has systematically investigated aspects of the TOT state and the type of information available. The TOT state is usually associated with words but it can be mediated by a range of stimuli. However, the occurrence of the TOT state with other types of stimuli has not been investigated widely.

Again through personal experience it is known that a situation that is similar to the TOT state can occur when listening to a piece of familiar music. In addition, from time to time, it has been observed that participants in commercial quizzes in the local media, when tested on extracts of popular songs, can be induced into a TOT state. It is observations such as these that led to the present study, which is an investigation of the TOT state induced by musical stimuli.

Several theorists, within the Psychology of music, have advanced the view that music is a language that shares many of the formal structural components of natural or verbal language. Several different lines of research have shown some support for this view. In particular, the hierarchially based natural language systems, derived from Chomsky's Transformational Generative Grammar, provide a reasonable model of some structural aspects of music. For example, Lindblom and Sundberg (1970) have analyzed Swedish nursery tunes by applying Generative Grammar, as has Chen (1983) with Gregorian chant. Lerdahl and Jackendoff (1983), have similarly found some success in applying models from Transformational Generative Grammar to music.

The argument has been developed by Bernstein (1976) from a musical point of view. Other musicians have developed the more general idea that music and natural languages share certain formal properties as means of communication. Cooke (1959) provides an entertaining example of this approach.

Further indirect support for the view that music is a language is the fact that many of the methods developed from natural language research are applicable to music.

Examples are provided by such diverse works as the research of Bever and Chiarello (1974) and the computer research based on statistical properties of music, e.g. Gardner (1978). Therefore, the underlying theoretical approach for investigating the TOT state induced by musical stimuli is that music can also be considered to be a language. Thus a TOT state induced by musical stimuli is simply a "lexical" error within the language of music. In order to differentiate between the TOT state induced by words, and the TOT state induced by melodies, the experimenter has coined the term the "Tip of the Ear" state or "TOE" state. This is hypothesized as the experience of listening to a song and knowing that it is familiar but being unable to retrieve its name from memory. As in the TOT state, it is hypothesized that other characteristics of the stimulus are known prior to naming it. In particular, two distinct components may play a part in the "Tip of the Ear" phenomenon. The inability to name a piece of music, while nevertheless being able to recall all of the relevant features of the melody, is closely analogous to the classical "Tip of the Tongue" phenomenon. However, an additional "Tip of the Ear" phenomenon is logically possible. This is the situation in which vague parts of a melody are available to memory, but other features of the melody cannot yet be recalled. This logical possibility, while of theoretical interest is not explored in this study. Instead the emphasis is upon the gradual recall of verbal information associated with the target melody.

This chapter will firstly consist of a review of the relevant literature on the Tip of the Tongue state and secondly, a review of the literature on melody recognition. Finally a rationale for the hypotheses and experimental design will be discussed.

1. LITERATURE REVIEW OF THE TIP OF THE TONGUE STATE

The Tip of the Tongue phenomenon was first systematically investigated in a classic experiment by Brown and McNeill (1966). Previously Wenzl (1932, 1936) and Woodworth (1934) had recorded data for naturally occurring TOT states, with German and English words. However, the work of these researchers can only be described as a subjective collection of examples of the TOT state, because the data consisted solely of examples of naturally occurring TOT states provided by the researchers themselves. In addition, only non-quantitative analyses were performed upon the data.

Realizing the limitations of this work, Brown and McNeill designed a technique which reliably induced the Tip of the Tongue state in an objective experimental setting. Brown and McNeill selected low frequency English words to induce the TOT state. Definitions of these words were read to the subjects, who were then asked to identify the target word. Subjects in whom this technique induced a TOT state completed a questionnaire which asked them to guess the number of syllables in the word, the initial letter of the word and to list words of similar sound and words of similar meaning.

The results showed 360 instances of the TOT state across 56 subjects and all words. The majority of instances were described as positive TOT states, where the target word was known and correct, thus the accuracy of information provided could be assessed. Overall, the data showed that in the TOT state, significantly accurate generic recall does occur. Generic recall of a word appeared to be of two types. Firstly, abstract generic recall was indicated because subjects were able to judge the number of syllables in a word. Also on the basis of evidence from the words of similar sound, subjects appeared to have some knowledge of the stress pattern of the target word. Secondly, partial recall was also observed. That is, subjects were able to provide information about the letters in the word and furthermore, they were able to judge very accurately the initial letter of a word. Using the data from the words of similar sound, a letter serial position effect was also found. That is subjects were able to recall the beginning and final letters of a word more accurately than those in the middle.

Any research on the TOT state ultimately pertains to the organization of memory and the information retrieving processes. From their findings, Brown and McNeill presented a general model of how words are stored in memory and the retrieval processes involved. Brown and McNeill suggested that "long term memory for words and definitions is organized into the functional equivalent of a dictionary." They viewed the mental dictionary as a keysorting system in which words are sorted and stored according to various linguistic features. They did not specify the nature of these features but suggested some of these features may be more prominent than others. According to Brown and McNeill, it is these prominent features which are used in word recall and perception. Two possible explanations for this were suggested.

Firstly, they postulated that only 'faint entries' of some features of words occur in the mental dictionary. For example, the middle letters in a word are entered more faintly in memory, than the initial and final letters of that word. The second explanation proposed that a word is represented more than once in memory, that is, it occurs on more than one 'card' in the 'mental index' system. Therefore the greater prominence of some features is due to the more prominent feature being entered on more 'cards'.

Baker (1974) in a discussion of models of the 'lexicon' or the speaker's internal store of words, discussed Brown and McNeill's experiment and model. Baker described Brown and McNeill's model as a 'performance' model of the lexicon because it attempts to account for performance data, namely generic recall of words. Baker criticized the validity of aspects of Brown and McNeill's findings. For example, Brown and McNeill suspected on the basis of the words of similar sound, that subjects had knowledge of the stress pattern of the target. However, much of the data in this category was eliminated because it did not meet the criteria, so that one must question Brown and McNeill's finding. Baker also criticized the use of certain statistical procedures that Brown and McNeill themselves had expressed some doubts about, with respect to their appropriateness.

Baker also questioned the validity of Brown and McNeill's model of the mental dictionary on the grounds that it attempted to explain how all words are stored when the data only deals with very rare words. Baker suggested these words may have been learnt at a much later stage of education and thus may be stored in a different way to normal everyday language learnt at an earlier age. Tweney, Tracz and Zaruba, (1975) however, in a subsequent line of research, extended the Brown and McNeill finding to common words.

Using a word association task, Baker experimentally tested this model of the lexicon and supported Brown and McNeill's finding that the best model of the lexicon is one based on an indexing of the representations of words according to certain features. However, Baker found support only for classification according to the first consonant and part of speech. The results of the experiment found that words are not subgrouped according to their middle consonant, their number of syllables or their final syllable. This disparity may be due to differences in types of words investigated and the means of access used. It may also be due to features such as the redundant structure of language and the manner of language acquisition.

Returning to the more direct investigations of the TOT state itself, Brown and McNeill's study has led to several other lines of research. For example, Browman (1976) and Koriat and Lieblich (1974) have, unlike Brown and McNeill, included some form of control condition in their experiments. This has meant that the significance of observed results in the TOT state can be more validly assessed.

Firstly, Browman (1976) studied the TOT state using naturally occurring TOT phenomena, because she felt an experimental technique may introduce artificialities into the situation. This was a unique approach which has not been repeated by any other researcher. Browman collected 113 target-approximation word pairs and compared each word in the pair to determine any common factors. However, prior to analyzing these, Browman established the chance level of similarities between the target and approximation words by making use of random word pairs. Therefore, this was a control condition used to test the significance of similarities between members of observed pairs throughout the study. The data indicated a number of factors are known about a desired target word prior to complete recall. These are semantic factors, syntactic category, number of syllables and what the consonants are: - both initially and non-initially, graphemically and phonemically.

Browman (1978) presented further research on the TOT state and proposed a possible mechanism for its occurrence. Browman suggested that this mechanism focuses attention on the beginning and end of the word and on the initial portion of the stressed syllable. Therefore, lexical errors such as the TOT phenomenon are a function of this mechanism operating during retrieval.

In the first of three papers, Koriat and Lieblich (1974) presented a more refined methodological analysis of the TOT phenomenon. Koriat and Lieblich (1974) believed that Brown and McNeill's experiment had been unequivocally accepted with no further developments since its publication. They argued that some of the results obtained by Brown and McNeill do not reveal information about how specific memory entries are stored and retrieved but instead could be attributed to chance. In order to allow for this possibility, they felt that a control condition should be included. They compared estimates of information available to subjects in the TOT state to a control condition, namely, a state in which a subject declares he has no knowledge of the solicited word. Koriat and Lieblich also proposed that Brown and McNeill's Tip of the Tongue state is an all embracing term and that in fact it covers five different substates as shown below:

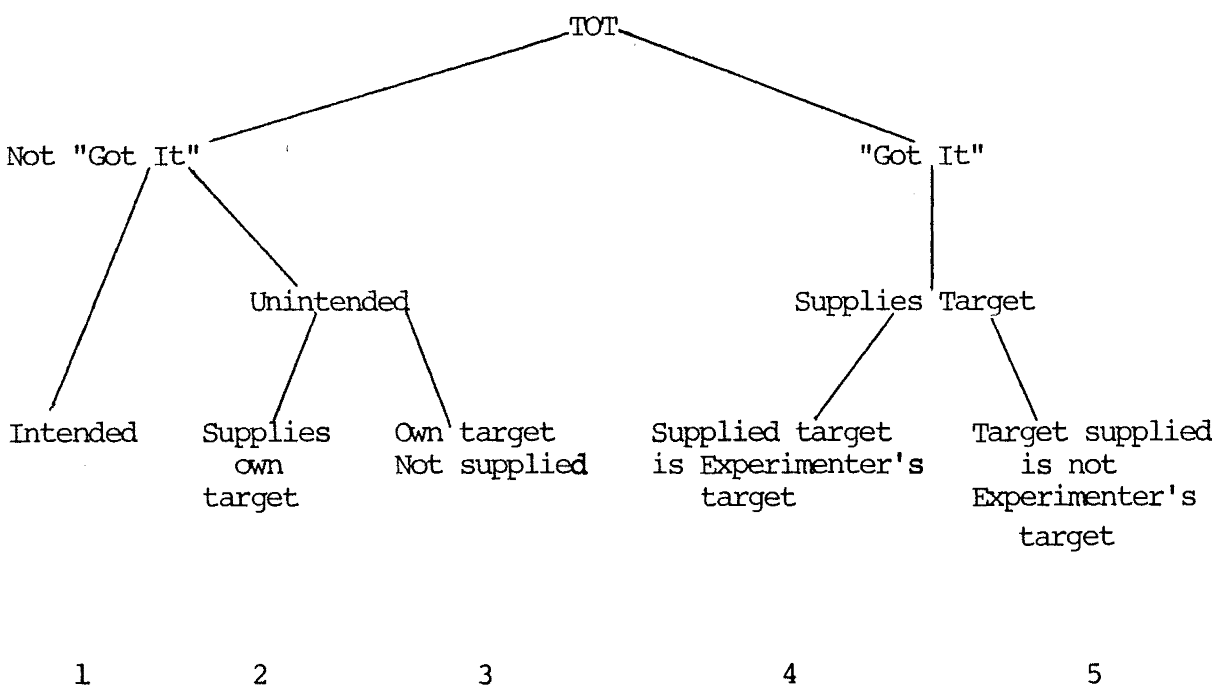


Figure I-I Koriat and Lieblich's TOT substates

Again, the experimental procedure was very similar to Brown and McNeill's experiment. Definitions of uncommon English words were presented and the subjects decided whether they were in a state of knowing, not knowing or a "Tip of the Tongue" state. If they knew the word (Know state), then they wrote "Know" and the word. Therefore, this word could be either correct or incorrect. If they were in a TOT state they indicated this and completed a questionnaire answering questions about the number of syllables, the initial letter of the word and so on. Thirdly, those who did not know the word (Don't know state), indicated this and completed the questionnaire as well. Those in either a TOT or "Don't know" (DK) state could also retrieve the missing word before they had finished completing the questionnaire. They then marked "Got It" as well. When everyone was finished, the experimenter read out the correct target word and the subjects compared their target word to this and indicated whether it was correct or incorrect. Those subjects in the TOT or DK states who either recognized or didn't recognize the Experimenter's target as the word they were searching for, were also classified as 'Intended' or 'Unintended' respectively.

The results were analyzed by classifing the responses into one of the following categories: -

State Number	Category
1	Know
2	Know - Incorrect
3	TOT - Intended
4	TOT - Unintended
5	TOT - "Got it" - Correct
6	TOT - "Got it" - Incorrect
7	DK
8	DK - "Got it" - Correct
9	DK - "Got it" - Incorrect

Koriat and Lieblich calculated the overall correct detection rates in the various Tip of the Tongue states and found that they vary greatly according to the substate. One factor which affected the results was the choice of criterion against which subjects' guesses were calculated. For example, when the subject's target differed from the experimenter's target, the subject's guesses predicted characteristics of the word declared by him to be his target, considerably better than characteristics of the experimenter's target. The TOT substate, State 3 was described as the state in which the subject never named their target, but when the experimenter read it out, the subject recognized it as his intended target. On the other hand, State 5, was a TOT substate in which the subject did correctly name the target before the end of the trial. In a comparison of the performance in these two TOT substates, higher correct detection rates occurred when recall is achieved before the end of the trial as in State 5, than when it is not. This replicates

Brown and McNeill's findings that the nearer a subject is to his target, the more accurate is his generic recall.

Overall, Koriat and Lieblich found that the various TOT states are clearly distinguishable from one another. Therefore, they believe that these states should be analyzed separately rather than amalgamating them into one TOT state.

Koriat and Lieblich (1975) presented a further analysis of their data. This was stimulated by Brown and McNeill's finding of a letter serial position effect or in other words, that subjects differentially recall letters in different positions in a word. This was evidenced by comparing words of similar sound provided by subjects in a TOT state to target words. Higher percentages of correct letter matches were obtained for letters in the initial and final positions than for letters in the middle position. Using the data collected in the 1974 study, Koriat and Lieblich compared letter matches between words of similar sound and the target word in two states, the TOT state, and the DK state. It was found that a higher overall detection rate did occur for the TOT state than for the DK state. When relating the detection rate to letter position, they also found differences in the two states. For the pure TOT state a "U" shaped function occurred, indicating better detection of the ends of words than the middle. This replicated Brown and McNeill's finding. For the DK state, the results suggested a shallow monotonic rise in detection rate from initial to final position. Koriat and Lieblich suggested that only the initial positions in a word yield a higher detection rate when a subject is in a TOT state. They explained that a relatively high detection of letters in later positions is more likely to be attributable to the organization of English words in general, rather than how words are stored and retrieved from memory. There is a smaller variety of letters appearing in later positions in English words, therefore the probability of an individual making a correct guess is greater.

In a final study by Koriat and Lieblich (1977) a different approach was taken, namely that of analyzing the stimuli. This was an attempt to identify characteristics of stimuli which may lead to a TOT state. Koriat and Lieblich defined the stimuli as memory pointers or any cue such as a word definition or question intended to specify a particular memory entry, whose retrieval is called for. Unlike past studies, Koriat and Lieblich, used the TOT judgements as dependent variables rather than as independent variables. One of the major findings of this study was that when memory pointers are mapped in terms of the memory states they induce, two distinct dimensions of pointers emerge. These are firstly, the effectiveness with which the pointer tends to suggest the intended target and secondly the degree of initial "feeling of knowing" evoked. This implies that in a search for information, initially an analysis of the content of the pointer to evaluate the chances that the information exists in memory occurs, and then perhaps successful retrieval. This may have the result that a memory search is not initiated, however memory scanning seems to occur regardless. Secondly, the fact that the dimension of feeling of knowing is distinct from actual knowing, suggests that the decision in the initial stage rests on aspects of pointer information different from those which may determine the success of the subsequent retrieval attempt.

There also appears to be a difference between factors pertaining to the nature of the target word and factors pertaining to the nature of the pointer. Pointer characteristics are more readily available for experimental manipulation. The findings suggest that pointer characteristics, when manipulated, can affect (a) some or all of the likelihood of correct retrieval, (b) the initial feelings of knowing and (c) the accuracy with which this judgement affects the actual retrieval. For example, adding redundant information should increase the overall initial feeling of knowing without necessarily affecting the likelihood of correct retrieval. Other manipulations such as specification of the class of words to which the solicited target word belongs should also increase the accuracy of initial feelings of knowing.

Koriat and Lieblich have presented a more refined analysis of the TOT research. They have shown that the TOT state is actually comprised of a number of different sub-states. They have also shown that characteristics of the stimulus will affect the likelihood of a TOT state.

Rubin (1975) also looked at the TOT state by analyzing the structure within each word used as a stimulus. Rubin believed that past research was limited because the data was analyzed across all target words and subjects. Thus, the structure of information from individual target words was lost. Rubin attempted to overcome this by testing a large number of subjects on only four target words. A free recall task was also used so that the size of the subject's knowledge about the target word could be assessed without actually specifying what was to be answered. The study found that individual target word clusters of letters tend to be retrieved together and these clusters are often morphemes. Rubin concluded that word-name memory includes at least morphemes or morpheme-like clusters. These clusters are organized to allow efficient utilization of information in the production and perception of language.

However, it must be stated that although Rubin attempted to overcome the limitations of past research, the information he provided is highly specific and therefore not very generalizable.

Associated with a TOT state are usually feelings of knowing the word. Feelings of knowing in themselves have been investigated. Hart (1965) argued that the feelings of knowing in the TOT state monitor memory content and motivate retrieval efforts. Therefore, this implies that feelings of knowing are valid indicators of the content of the memory store and secondly, that feelings of knowing govern the activation and maintenance of retrieval processes. Hopkins and Atkinson (1968) and Gruneberg, Monks and Sykes (1977), demonstrated that subjects do spend more time searching for "forgotten" words for which they have experienced TOT states than for those which they do not know. Ryan, Petty and Wenzlaff (1982) investigated firstly, the motivational consequences of feelings of knowing and secondly, the attentional demands of the TOT state. Ryan et al. used a dual task technique and found that TOT states are associated with the disruption of a concurrent capacity-demanding task while 'Don't know' states are not. The findings also supported Hart's view that feelings of knowing not only monitor memory content but also control memory processing. TOT states were associated with changes in capacity-allocation priorities in the memory system. That is, the attentional capacity denied a second-task, in this case a number-probe task, during TOT trials is reduced and reallocated to covert retrieval tasks.

As can be seen, the research has concentrated upon using word definitions as the stimuli to induce a TOT state. It was mentioned in the introduction that non-verbal situations have also been investigated with respect to TOT states. Two studies in particular have induced a TOT state using other types of stimuli.

Yarmey (1973) used pictures of famous faces as stimuli to precipitate the TOT state. Yarmey based his technique upon past research which showed that nonverbal imagery is as important in memory tasks as verbal imagery (Paivio 1971; Richardson 1969; Segal 1971; Sheehan 1972). A very similar experiment to that of Brown and McNeill was used except that photographs were presented as stimuli and slightly different questions such as the person's profession were asked. The results showed 623 TOT instances across all faces and all subjects. The results added support to Brown and McNeill's generic recall interpretation of memory. Phonemic information of words was available and consistently accurate. However, in the light of Koriat and Lieblich's research, a more refined analysis of this data is possible. Yarmey did find support for his view that nonverbal imagery also mediates the memory search. To conclude, the study showed that the TOT state is not only limited to acoustically related words. Although verbal representations are the targets in TOT states, several retrieval systems are apparently used to locate the to-be-remembered name. This is a very similar situation to one where one is confronted by a former associate, but cannot quite recall his or her name to memory.

The second study which has used stimuli other than word definitions was conducted by Lawless and Engen (1977). Lawless and Engen used paradigms from verbal learning and semantic memory to investigate the nature of odour memory. A TOT type of experiment investigated the retrieval of odour names from memory. Lawless and Engen coined the term "Tip of the Nose" phenomenon for the sensation of extreme familiarity with an odour but difficult identification. This experiment attempted to answer such questions as - What sort of partial information is available in the Tip of the Nose state? Does the subject merely lack the word for the odour, that is, is he merely in a Tip of the Tongue state? How good a grasp of the odour quality does the subject have?

Odorants from a range of sources were presented to subjects who rated their familiarity with the odorant. Those subjects who made a high familiarity judgement, and who were unable to name the odour and who felt they were in a Tip of the Nose state completed a questionnaire. The questionnaire consisted of questions concerning the odour quality such as:

Can you name a similar odour?

Can you name a general category for the odour?

Can you name an object from which the smell might have come?

There were also questions concerning the odour name.

The results showed 37 instances of Tip of the Nose states across 12 subjects and all odorants. There appeared to be a difference between the Tip of the Nose state and the Tip of the Tongue state. Subjects in a Tip of the Nose state could often name a similar odour or the general category to which the odour belonged but were unable to provide information about the name of the target odour. Curiously, reading the dictionary definition of the odour led the subject to a correct identification in 16 out of 23 instances whereas reading the definition of the word would more generally induce a TOT state. The Tip of the Nose state does however resemble the TOT state in that hints or suggestions can lead to the correct name.

2. LITERATURE REVIEW OF MELODY RECOGNITION

As outline in the introduction, this study is an investigation of the TOT state when induced by musical stimuli. Although the study basically involves an application of psycholinguistic techniques to musical stimuli, components of melody recognition are also central to the study. The task requires a suitably transformed melody that will be capable of inducing a TOT state. It is thus important to review the past literature on melody recognition from a methodological point of view, and also to identify the components of a melody which aid recognition. Therefore, this section reviews the pertinent research on the recognition of melodies.

Little interest has been displayed in the field of melody recognition, in comparison to the field of shape recognition. Early research on the recognition of auditory patterns used recorded speech as the stimulus material. Stimulated by the pioneering work of Werner (1926), White (1960) investigated the recognition of melodies upon which various transformations were performed.

White (1960) felt that the sequence of intervals between adjacent notes may carry information which facilitates melody recognition. Therefore, 12 different transformations involving operations on the intervals between adjacent notes in a melody were performed on a set of ten well known tunes.

These transformations included: -

1. Doubling the size of the intervals (i.e. a 1 note interval became a 2 note interval).
2. Increasing the size of the interval by 1 tone.
3. Using random intervals.
4. Setting all notes to the same frequency but leaving the duration unchanged. (i.e. only rhythm retained).
5. Playing the melodies backwards.

The results showed that the melodies were familiar as 94% correct identifications were made when the melodies were played without any transformations. The results generally indicated that melodies were least disrupted by linear transformations which uniformly increased or decreased the size of the musical intervals. Non-linear transformations such as random intervals and the complete reversal of the melody were more difficult, equalled only by the complete elimination of pitch information. The effect of temporal polarity is recognizable in language as well. That is, reading backwards produces a similar decrement in recognition to that found for reversed melodies.

Dowling (1972) presented further research on the recognition of melodic transformations. This was very similar to White's research except familiar melodies were not used. Dowling aimed to avoid the rhythmic dimension present in actual music and thus the melodies in this recognition experiment were selected to provide maximal homogeneity. Dowling investigated three transformations - inversion, retrograde and retrograde inversion. All of these occur constantly in music. Dowling found an ascending order of difficulty in these transformations: this order was inversion (least difficult), retrograde, and retrograde inversion (most difficult).

Deutsch (1969) proposed a neurological network to account for the abstraction processes used in music. This accounted for the three main processes of interval abstraction, abstraction of chords consisting of at least three notes and also identification of tones separated by octaves. Deutsch proposed an auditory version of Hubel and Wiesel's (1962) model.

A series of papers have been concerned with octave generalization. It had long been recognized that tones which are separated by octaves, that is, their frequencies stand in the ratio of a power of 2:1, have an essential similarity. This is known as octave generalization and is a powerful factor in the processing of musical information. Deutsch (1972) investigated octave generalization using the tune "Yankee Doodle". The tune "Yankee Doodle" was played to subjects in any one of three different octaves. Recognition on this task was immediate and total. Then, the tune was played in such a way that it randomly jumped over three octaves. The correct notes were preserved, but the octave in which the notes were played was randomly varied. In this case, the tune became unrecognizable. Deutsch assumed that the auditory channel that is involved in processing tunes does not exhibit octave generalization.

Dowling and Hollombe (1977) extended Deutsch's "Yankee Doodle" effect to other well known tunes and to different timbres. In the first experiment, Dowling and Hollombe established the same effect as Deutsch found. In a second experiment, Dowling and Hollombe found that timbre did not alter the effect. There was however, variability in recognition between the various tunes. As well, in the second experiment, random octave leaps were applied but the overall melodic contour was preserved. The preservation of contour improved recognition over the purely random transformations, but only when the subjects were made aware that the contour had been preserved.

Dowling and Hollombe discussed the results of the experiment as an example of the difficulty listeners have in achieving coherent perceptual organization when the stimulus contains wide leaps of pitch. The distortion of melodies in these experiments violates the Gestalt principle of proximity in figural organization. Preserving some of the familiar proximity of notes (i.e. the contour) in a melody can aid recognition.

House (1977) also extended Deutsch's "Yankee Doodle" effect. Four melodies were presented with identical rhythms in order to eliminate the problem of recognition on the basis of rhythmic information. The harmonic content of the constituent tones of the melodies was also manipulated. Subjects listened to all of the distortions in either sine-wave, sawtooth or rectangular waveform tones. This was to determine the influence of the harmonic content of tones on recognition of the distortions.

The results indicated that differences among melodies exist which result in some melodies being more easily recognized than others in the random octave distortion. In an alternating octave condition, support for octave generalization was found. House suggested that in addition to octave generalization, harmonic generalization may occur. However, this requires further research to determine if there is an analogue of octave generalization relative to the other intervals present in music.

Dowling (1973) investigated the perception of interleaved melodies. This was an application of the Gestalt principles of organization to music. In the first experiment, it was found that identification of interleaved pairs of familiar melodies is possible if their pitch ranges do not overlap. This demonstrates that perceptual grouping may be based on pitch alone. In a second experiment, consisting of a short-term recognition-memory paradigm, interleaving of 'background' melody with an unfamiliar melody interfered with judgements regardless of the separation of their pitch ranges. When the pitch ranges were separated however, the interference effect was eliminated. If the target melody was prespecified, then listeners could overcome the interference effect and recognize a familiar melody. Deutsch (1982) presented further research on the application of Gestalt principles of organization to music.

From a methodological point of view, the above discussion of the research on the recognition of transformed melodies is of direct relevance to this study. The techniques of transforming the melodies in this past research were the basis for developing a new type of transformation which was applied in this study. As well, this past research has determined the type of stimuli, that is, well known melodies and the presentation of the stimuli through the use of a computer.

Other aspects of melody recognition have also been investigated and although of peripheral relevance; these will be briefly surveyed.

Cuddy and Cohen (1976) investigated the interesting problem in music perception of transposition. When a melody is transposed, the absolute frequencies of the tones of the melodies are changed. Yet, a melody is recognized with ease even though it may be translated into a different key. Therefore, the frequency ratio between successive tones is the only frequency information that is preserved. Cuddy and

Cohen measured the recognition of short (3-note) melodic seqeuences and compared this to models of recognition, each of which described a different degree of abstraction and synthesis of the musical intervals contained in the sequence. The results showed that subjects with musical training were able to abstract and synthesize the musical intervals between both adjacent and non-adjacent tones. For subjects without musical training, recognition was less accurate but there was evidence that intervals between adjacent tones were abstracted.

Dowling (1978) examined recognition memory for transposed melodies and found that in certain cases listeners could differentiate between one melodic fragment and a transposed version of it. The distinction was made when the structure of the original melody confirmed to a structure possible within a diatonic scale. Therefore, the diatonic scale is of prime importance in the recognition of melodies as well.

Cuddy, Cohen and Miller (1979) investigated the effects of different tonal contexts on the recognition of a transposed sequence. The melody was presented either without context or embedded in one of three contexts. The results showed significant effects of contextual conditions.

Tan (1979) investigated the detection of tonic and non-tonic sequences in a melody. Tan believed that experienced musical subjects would anticipate movement towards the tonic in a melody whereas inexperienced subjects would not be aware of this. However, the results did not support this view. The detection of tonic and non-tonic tonal sequences within melodies is dependent on prior training only to the extent that this experience develops the use of strategies of tonal organization. Vocal training appeared to encourage this.

Finally, little work has been conducted on the effects of rhythmic information on melody recognition. In a series of experiments, Kidd, Boltz and Reiss Jones (1984) found that rhythmic context had marked effects upon both melodic discriminability and general cognitive biases in judging melodies. For example, if gross rhythmic features were alike, then melodies were also judged to be alike. The rhythmic information tended to bias melody judgements.

As said earlier, the most relevant research to this study is the research on recognition of transformed melodies. The key aspects in melody recognition research in general have also been identified. These are transposition, effects of context and rhythmic information.

3. HYPOTHESES

As can be seen from the literature review, the TOT state has previously only been considered as a linguistic error in the context of natural, verbal language. In the present research, attempts will be made to induce the TOT state using music and emphasis will be placed upon the amount of musical knowledge or information that the subjects possess about the target melody. As mentioned in the introduction, the underlying argument for investigating the TOT state induced by musical stimuli is that music can also be considered to be a language because it has many similarities in common with natural, verbal language.

Thus in terms of the experimental hypotheses, the main hypothesis is:

Hypothesis Number One: That a TOT state can be induced by musical stimuli.

Other, more specific experimental hypotheses are generated from Brown and McNeill's (1966) findings. To recapitulate, Brown and McNeill found that a subject in a TOT state displays partial recall of the initial letter of the target word, the number of syllables in the target word, the stress pattern of the target word and can name words of similar sound, prior to recalling the target word. Therefore, the present research attempts to translate these findings in terms of the musical information available. The hypotheses of Yarmey (1973) and Lawless and Engen (1977) which were based on the inducement of a TOT state using other types of stimuli, were of assistance in this context.

A second broad hypothesis based on the view that Brown and McNeill's findings are examples of partial recall measures is:

Hypothesis Number Two: That partial recall of specific types of information will occur significantly before the point of recognition of the target melody.

The next five hypotheses concern the type of information which will be recalled prior to the point of recognition.

Hypothesis Number 2.1: That subjects will possess knowledge of the rhythm of the target melody prior to recalling completely the target melody.

Hypothesis Number 2.2: That subjects presented with the first few notes of a melody will possess knowledge of a later melodic sequence of notes in the target melody.

Hypothesis Number 2.3: That subjects will possess knowledge of the category of the melody (i.e. Christmas carol, hymn, pop song), before they are able to name the target melody.

Hypothesis Number 2.4: That subjects will be able to name similar sounding melodies to the target melody.

<u>Hypothesis Number 2.5</u>: That subjects will be able to name some of the words from the target melody.

It is also proposed that there may be a systematic progression of occurrence of this recalled information between subjects and across melodies. That is, it may be possible to construct a sequence of stages of partial recognition moving from complete failure on the tasks through to complete recognition. An hypothetical example of this is illustrated below:

Trials 1 ____ 10

Nothing recognized	Rhythm correct	Tune Type Recognized	Complete Recall

<u>Hypothesis Number Three</u>: That a systematic progression of the occurrence of recalled information exists prior to the point of recognition, both across melodies and between subjects.

Two experientially based factors are hypothesized as possibly influencing the results. It is proposed that subjects with musical experience such as tuition in a musical instrument or singing may perform significantly better in the partial recall tasks than those subjects who are musically inexperienced as indicated by an absence of any form of musical tuition. That is, subjects who are musically experienced may be more highly sensitized towards the various components of a melody and thus retain more musical information about a melody. Therefore they will show better performances on the partial recall tasks.

Hypothesis Number Four: That subjects classified as musically experienced will perform significantly better on the tasks testing partial recall of specific types of information than those classified as musically inexperienced.

A second, experiential factor that may influence the subject's performance is proposed. A pre-listening condition, in which subjects listen to the melodies prior to the experimental session may produce significantly better performances in the partial recall tasks. Although, the subjects would be unaware that the melodies include the target melodies, they may retain these melodies in short term memory. Therefore, hearing them in the experimental session would "bring them to the surface again."

Hypothesis Number Five: That subjects listening to a set of melodies in a pre-listening condition will perform significantly better on the tasks testing partial recall of specific information than subjects who listen to the melodies in a post-listening condition.

To summarize then, the five hypotheses are:

1. That a Tip of the Tongue state can be induced by musical stimuli.

2. That partial recall of specific types of information will occur significantly before the point of recognition of the target melody.

   2.1 That subjects will possess knowledge of the rhythm of the target melody prior to completely recalling the target melody.

   2.2 That subjects will possess knowledge of a later melodic sequence drawn from the target melody.

   2.3 That subjects will possess knowledge of the general category of the melody (i.e. Christmas carol, hymn, pop song).

   2.4 That subjects will be able to name similar sounding melodies to the target melody.

   2.5 That subjects will be able to produce some of the words from the target melody.

3. That a systematic progression of occurrence of recalled information exists prior to the point of recognition, both across melodies and between subjects.

4. That subjects classified as musically experienced will perform significantly better on the partial tasks testing recall of specific information than those classified as musically inexperienced.

5. That subjects listening to a set of melodies in a pre-listening condition will perform significantly better on

the tasks testing partial recall of specific information than subjects who listen to the melodies in a post-listening condition.

CHAPTER II

METHOD

1. DESIGN:

A 2 x 2 factorial design with independent measures was used. Ten subjects were selected to be assigned to the musically experienced group and another ten to the musically inexperienced group. Subjects were then randomly assigned to either a pre-listening condition where they heard a tape of the tunes prior to the experiment, or a post-listening condition where they heard the tape after the experiment.

There were five subjects in each cell of the 2 x 2 design and the order of presentation of the seven tasks in each trial was constant. The following order was fixed by the structure of the computer program and was used throughout the experiment:

1. Clapping the rhythm of the extract they heard.
2. The 'Snatch' task, for testing recognition of a sequence drawn from a later part of the melody.
3. Naming the title of the melody.
4. Rating their familiarity with the melody.
5. Naming the category of the melody.
6. Naming similar sounding melodies.
7. Naming some of the words appearing in the melody.

The overall independent variable is the subject's tendency to be induced into a TOT state by musical stimuli. In essence, each of the measures gained from the seven tasks listed above measures an aspect of the dependent variable.

(1) Stimuli

The first 20 notes of ten melodies were used as stimuli. These melodies were selected using two criteria: the melodies were judged to be well known songs from a range of sources, and they were all of a similar moderate speed. Originally, 20 melodies were selected and are present in the computer program, (Appendix A) however, this number was too large to be practical for the subjects, because of the time required to listen to them all. For practical reasons, then, this original set was reduced to ten melodies, consisting of the following:

	Title	Classification
1.	Away in a Manger	Christmas Carol
2.	Pop Goes the Weasel	Nursery Rhyme
3.	The First Nowell	Christmas Carol
4.	Hey Jude	Pop Song
5.	Amazing Grace	Hymn
6.	The Lord's My Shepherd	Hymn
7.	Sing a Song of Sixpence	Pop Song
8.	Raindrops keep falling on my head	Pop Song
9.	O Little Town of Bethlehem	Christmas Carol
10.	O Come All Ye Faithful	Christmas Carol

2. MATERIALS:

(1) Task Sheet

During the experimental session, each subject completed a task sheet for each test melody. This included written instructions and a set of seven questions for each trial on which a given test melody was presented. The task sheet is reproduced in Appendix B.

(2) Tape

A pre-recorded tape of 30 well known melodies was produced using an Electronic Music Studio SYNTHI AKS. The 30 melodies consisted of the ten target melodies and 20 miscellaneous melodies. They were played as melodic line only, without harmony, in both the computer program and this presentation tape.

An answer sheet accompanied the tape recording. This consisted of a random ordering of the titles of 40 melodies. Again, these were the 30 melodies presented on the tape and another ten 'filler' melodies. While listening to the tape, subjects placed a tick beside those melodies which they thought they had heard. The answer sheet is reproduced in Appendix C.

The tape was used to gain a measure of the familiarity that subjects had with the melodies, and to determine whether prior exposure to the set of the melodies that were to be used in the session, had an effect on performance in the experimental tasks.

(3) Musical History Questionnaire

Prior to the selection of subjects, volunteers were requested to complete a questionnaire giving details of their musical experience, and their availability for testing. The questionnaire was used to assign volunteers to either the musically experienced group or the musically inexperienced group. The questionnaire is reproduced in Appendix D.

3. APPARATUS:

A Commodore 64 computer was used to run the experiment. This was used for the production of the ten test melodies and the 'Snatch' task. The C64 computer contains a sophisticated sound synthesizer chip, the sound interface device (SID), that is easily accessed from BASIC language.

One terminal was used which was controlled interactively.

Computer-synthesized music was selected firstly, because it was a novel and highly standardized method for presenting the stimuli, and secondly and most importantly, because it was the most efficient and simplest mode for performing the various transformations upon the melodies that were used. Alternatively, the music could have been produced on an instrument such as a piano but this would have been time consuming and the standardization of stimuli across subjects would have been difficult.

One computer program was used to run the entire experiment. This was written in BASIC with the following requirements in mind: -

1. To provide a practice trial for subjects.
2. To produce a set of ten test melodies and to rescale them all to a common key.
3. To randomise the order of presentation of the ten melodies and other events within each trial.

4. To systematically present ten trials in which more and more of each test melody was played in the following manner: -

TRIAL	PRESENTATION
1	From the 10th note to the 20th note
2	From the 9th note to the 20th note
3	From the 8th note to the 20th note
4	From the 7th note to the 20th note
5	From the 6th note to the 20th note
6	From the 5th note to the 20th note
7	From the 4th note to the 20th note
8	From the 3rd note to the 20th note
9	From the 2nd note to the 20th note
10	From the 1st note to the 20th note

5. To provide cueing for the experimenter and subject on a selection of musical performance tasks.

All melodies were rescaled to the key of C Major so that recognition on the basis of different keys was not possible. The full program is listed in Appendix A. The sequence of events is as follows: -

Firstly, a practice trial using the melody of 'Frere Jacques' was presented. This consisted of the melody line of the tune 'Frere Jacques' played from the beginning to the 20th note followed by a typical test version such as Trial 1 (i.e. the 10th note to the 20th note of the melody).

Following the practice session, data for 20 melodies was read into the computer to begin the main experiment. Ten trials of each melody were presented as outlined previously.

In order to prevent the occurrence of a systematically poorer performance on the first test melody due to unfamiliarity and lack of practice with the tasks, each subject began the experiment on a different melody. i.e. the melodies were cyclically rotated across subjects. For example, Subject 1 began on Melody 1 and carried on in order through to Melody 10, whereas Subject 8 began on Melody 8 and then did Melodies, 9, 10, 1, 2, 3, 4, 5, 6, 7 in that order.

Two different musical performance tasks were initially incorporated in the computer program.

The first referred to as the 'Probe tone' was not however, used in the experiment, because it was found during a pilot study to be too difficult for the subjects. This Probe tone task consisted of the presentation of five chords and then the subject had to judge which chord fitted best with the final tone of the melody. On each trial the melody itself was transposed into a randomly selected key. Therefore, this was testing the subject's knowledge of the tonality or key of the melody. A computer program for this task is included in Appendix A.

A second musical performance task was found more suitable. This was the 'Snatch task.' The first 25 notes of each melody had been read into the computer and in the

Snatch task notes 23, 24 and 25 of each melody were presented. These three notes were played to the subject who judged whether they were a later part of the melody they had just heard, or if they were from a completely different melody. The computer was programmed to randomly select the three notes from any of the melodies and play them to the subject on 50% of the trials, and to play three notes from the target tune on the remaining 50% of the trials. Thus on each trial there was a 50% chance that the Snatch had been drawn from the target tune.

The computer program included many prompts which allowed time in the experiment for subjects to complete tasks, by experimenter intervention at the keyboard.

The experiment was conducted in a sound-proof room in the Psychology Department of the University of Canterbury.

The audio output from the computer was fed to an audio-amplifier and two loudspeakers. The subject sat between the two loudspeakers and was positioned so they were unable to see the screen of the computer. The layout of equipment is illustrated in Appendix E.

4. SUBJECTS:

Twenty adult volunteers drawn from second-year Psychology undergraduate classes served as subjects. There were 15 females and 5 males ranging between 19 and 35 years of age, with a mean age of 20 years.

The subjects were selected to fall into two groups in terms of their musical experience, which was defined in the following manner. Those who had studied music on a regular and individual basis for more than a one-year period were classified as musically experienced. Conversely, those in the musically inexperienced category had never received any form of music tuition except that included in core school music. The sample included ten musically experienced subjects and ten musically inexperienced subjects. The ten subjects in the musically experienced category had a mean of six years of regular and individual music tuition.

5. EXPERIMENTER

Although the stimulus presentation was computer-controlled and semi-automated, the experimenter was present at all experimental sessions.

The experimenter's duties were twofold. Firstly, she was required to expand upon the explanation of the procedure of the experiment that was provided in the computer program. The stimulus presentation was computer-controlled, but the program was written in such a way that the sequence of trials could be interactively paced by the experimenter sitting at the computer keyboard. The program was written to include a series of pauses, during which the subject was to respond. The experimenter interacted with the program through the computer keyboard to initiate each trial.

Secondly the experimenter assessed the responses to the first question in each trial. This involved assessing the accuracy with which the subjects clapped the melody. The experimenter had obtained previous experience with this type of task through aural tests in formal A.T.C.L. music examinations. Subjects also responded verbally to the third question "Did you know the name of the melody you just heard?", and the experimenter assessed the accuracy of these responses.

6. PROCEDURE

The experiment was conducted individually for each subject. Once the subject was seated, sound levels of the tape recorder and the amplified computer music were adjusted to suit the subject.

Subjects in Condition A, the pre-listening condition, first listened to the tape recording of 30 melodies. Subjects in Condition B, the post-listening condition, did this at the end of the experimental session. This section took, on average, 15 minutes.

After that the subjects were given ten task sheets and instructed to read the written instructions which explained what they were to do in the experiment. To ensure that the subject fully comprehended the tasks involved, the experimenter orally briefed the subject about the procedure as well. A practice trial using the melody 'Frere Jacques' was then presented to the subject. This consisted of a version of 'Frere Jacques' played from the beginning to the 20th note. Next, the subject heard Trial 1 which consisted of the melody played from the 10th note to the 20th note. The subject then completed the seven tasks using this trial as the stimulus. If the subject had no problems with this, then the experiment began.

The subjects were first presented on Trial 1 with a particular test melody played from its 10th to its 20th note. The starting position in the set of 10 melodies was cyclically varied across subjects as outlined previously.

After listening to the melody, subjects were required to complete all of the tasks for that trial. These consisted of (1) clapping the rhythm of the extract they heard. The accuracy of this was judged by the experimenter and recorded in a data book. (2) The Snatch task was presented and the subjects crossed out Yes/No on their data sheet, according to whether or not they judged this snatch to constitute a later part of the same melody. (3) The subject was requested to name the melody if possible. Close approximations to the correct name were accepted as well as alternative well known names. For example, 'O Come All Ye Faithful' is also known as 'Why are we waiting'.
(4) Subjects rated their familiarity with the melody, using a 10 point scale on which 7 was anchored to the category 'never heard it before' and 10 was defined as 'know it'.
(5) The subjects were then required to classify the melody according to the seven categories of melodies outlined earlier.
(6) Subjects were asked to name a similar sounding melody.
(7) Finally, they were asked to name some of the words of the melody.

If subjects were unable to perform any of the tasks, then they left the appropriate space blank, on their answer sheet.

For the first two tasks, the clapping task and the Snatch task, a criterion of two correctly performed consecutive trials was set as the level of performance at which the response was to be scored 'correct'. Once this criterion was reached, the subject was no longer required to perform that particular task. This was to prevent boredom and frustration developing in the subjects.

If at any stage, the subject was able to name the melody, then they orally informed the experimenter who assessed the accuracy of the answer. If the subject was correct, then a new test melody was begun. Otherwise, the trials of each melody continued until the subject was able to correctly name the melody or until ten attempts had been made. It follows therefore that a subject could perform a maximum of ten trials of each melody and still be unable to name the melody. In such cases that sequence was discontinued and the next melody in the set was presented from its initial starting position.

All ten of the test melodies were presented in one session for every subject. The sessions were on average 90 minutes in duration. Four of the twenty subjects were tested on 20 melodies because they were very fast at recognizing the first ten melodies. However, this additional data is not included in the results. At no stage throughout the experiment did the experimenter inform the subjects of the titles of the melodies apart from at the end of the session, at which time the subjects were also informed of the general purpose of the experiment.

CHAPTER III

RESULTS

This chapter presents statistical analyses of the data in terms of the proposed hypotheses. In all cases, probabilities reported are two-tailed.

1. POINT OF RECOGNITION

The calculation of a point of recognition for each melody was the first step in analyzing the data.

A point of recognition was calculated by combining the data from two different sources. These were the measures of (1) the average trial for all subjects on which the melody was named and (2) the average trial for all subjects on which the Snatch task was recognized. These two measures were significantly correlated ($r = 0.55$, $df = 18$, $p < .02$) indicating that it is legitimate to combine the data from these two sources. The points of recognition also provide a general index of the difficulty of recognition of the various melodies.

Table 3-1 presents these indices of difficulty of recognition for each melody.

Table 3-1: Index of Difficulty of Recognition of Melodies based on the combined data from naming the melody and the snatch task

Melody	Mean Point of Recognition
1	4.76
2	2.14
3	2.65
4	3.05
5	2.69
6	3.27
7	3.21
8	3.62
9	3.32
10	5.29

Melody 2 is therefore the most easily recognized melody in the set; Melody 10 proved to be the most difficult to recognize.

By pooling the data across melodies, indices of difficulty of recognition within subjects are also obtained (Table 3-2):

Table 3-2: Index of Difficulty of Recognition within subjects based on the combined data from naming the melody and the snatch task

Subject	Mean Point of Recognition
1	3.27
2	4.1
3	3.72
4	2.1
5	3.3
6	3.36
7	4.02
8	2.6
9	3.62
10	4.02
11	2.9
12	2.97
13	2.6
14	2.7
15	3.52
16	4.17
17	4.3
18	3.57
19	3.5
20	3.58

Clearly, some subjects performed better than others on the tasks.

A point of recognition based solely upon the data gained from the task of naming the melody is necessary as well. This point of recognition is more applicable to some tasks such as categorizing the melody than a combined point of recognition. In actual fact, this point of recognition has been used more frequently in the analyses than the previous one.

Table 3-3: Index of Difficulty of Recognition within subjects based on naming the melody data only

Subject	Mean Point of Recognition
1	7
2	4.86
3	5
4	1.5
5	3.12
6	4.4
7	7.25
8	2.4
9	4.2
10	4.62
11	3.11
12	4.2
13	3.11
14	4
15	4.2
16	5.6
17	6.5
18	5.25
19	5
20	8.5

The calculation of the point of recognition is an important part of the data analysis as many of the hypotheses are tested by measuring deviations from the point of recognition of a melody.

2. FAMILIARITY WITH MELODIES

Surprisingly, subjects recognized only 60% of all the melodies they heard on the tape in the pre- and post-listening conditions. This is an indication of the difficulty in selecting melodies which will be well known to a range of subjects.

3. HYPOTHESIS 1

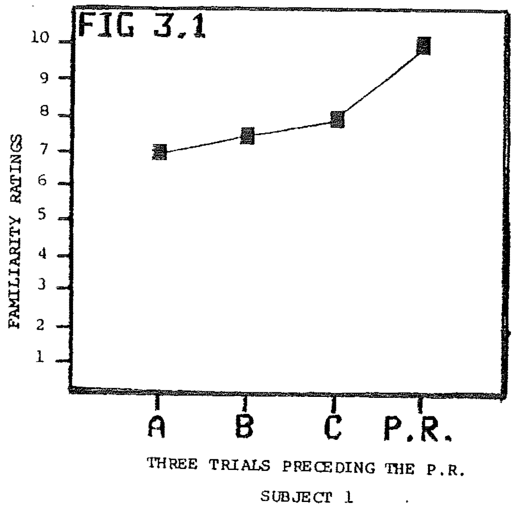
Hypothesis 1 stated that a TOT state will be induced by musical stimuli. The TOT state is characterized by increasing familiarity with a target object while being unable to name it. Therefore, a monotonic increase in familiarity ratings prior to naming the melody is evidence of a TOT state induced by musical stimuli.

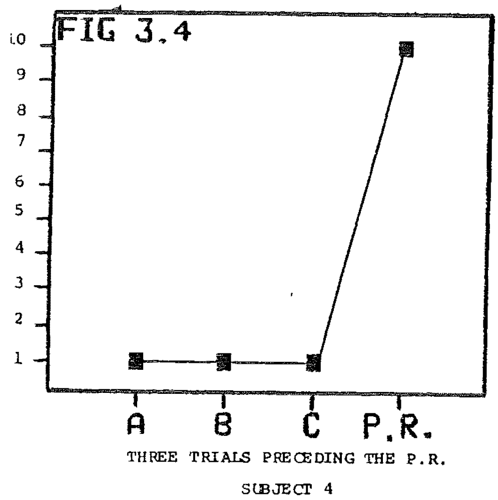
Mean familiarity ratings taken over the three trials leading up to the point of recognition within subjects are graphed in Figures 3-1 to 3-20. At the point of recognition, a familiarity rating of 10 is given - at this point the subject knows the melody.

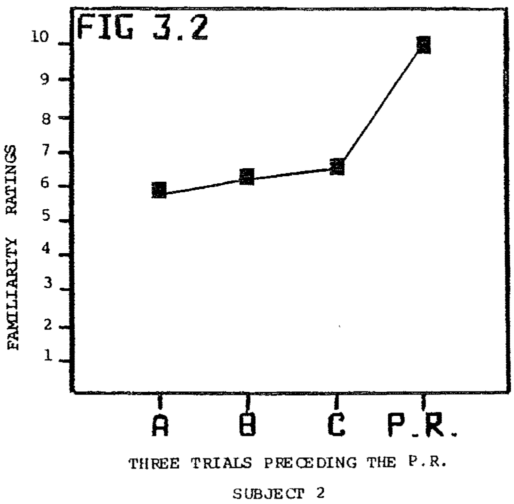
Visual inspection indicates that the majority of subjects had increasing familiarity ratings on the three trials preceding the point of recognition, even though at those stages the subjects were unable to name the melodies. The data is also presented in tabular form in Table 3-4.

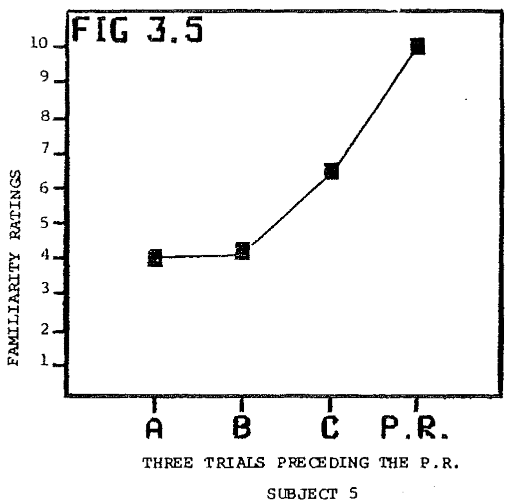
Table 3-4: Mean Familiarity Ratings on three trials prior to the point of recognition, within subjects

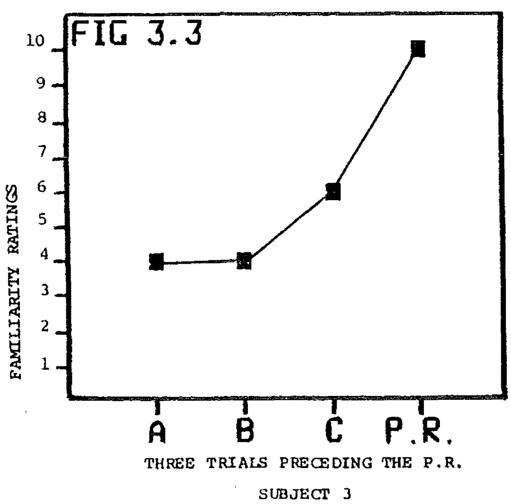
Subject	A	B	C	P.R
1	7	7.5	8	(10)
2	5.9	6.3	6.6	
3	4	4	4	
4	1	1	1	
5	4	4.25	6.5	
6	5	6	8	
7	5.75	6	6.75	
8	5	5	6	
9	3.75	3.7	3.9	
10	3.6	3.7	3.9	
11	3.25	4.5	4.5	
12	2.5	4.5	5.25	
13	5.9	6	6.1	
14	6.5	6.5	7.5	
15	2.5	4.5	4.5	
16	5.3	6	6	
17	3.25	3.5	4	
18	6	6	6.6	
19	4.75	5.5	6.25	
20	5.5	5.5	5.5	

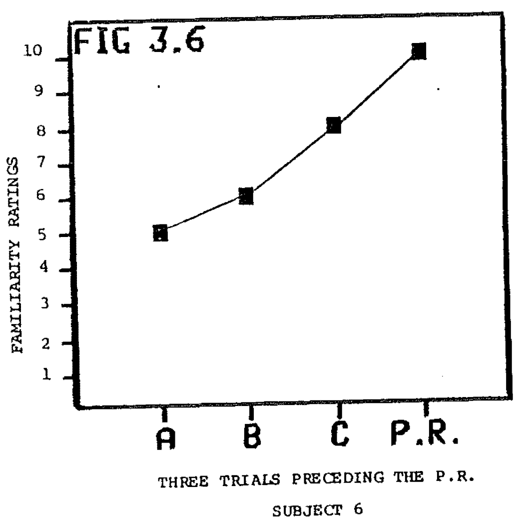






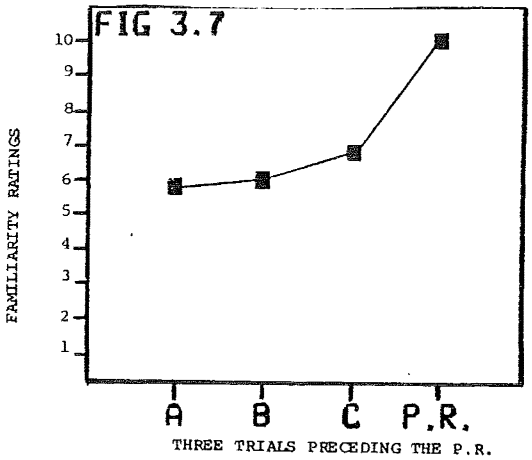




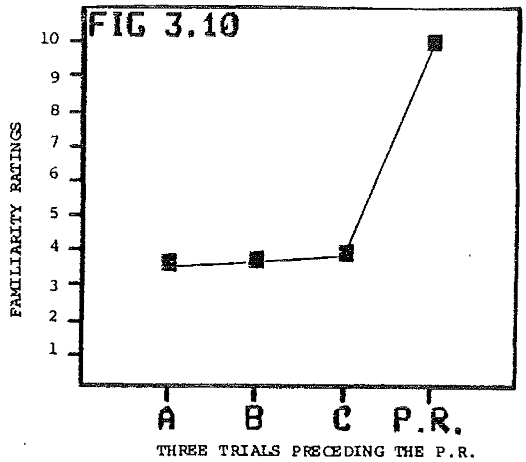


Figures 3-1 to 3-6

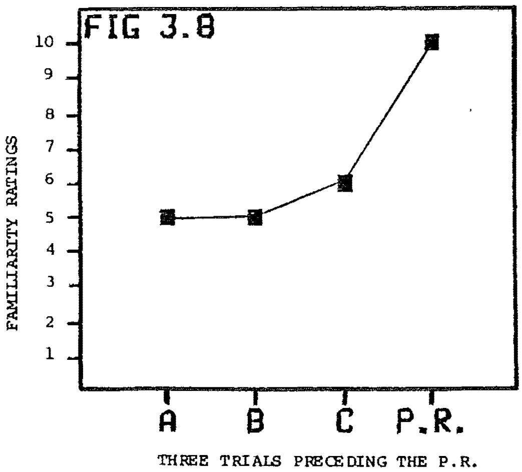
Mean Familiarity Ratings on the three trials preceding the Point of Recognition (P.R.) for Subjects 1 to 6.



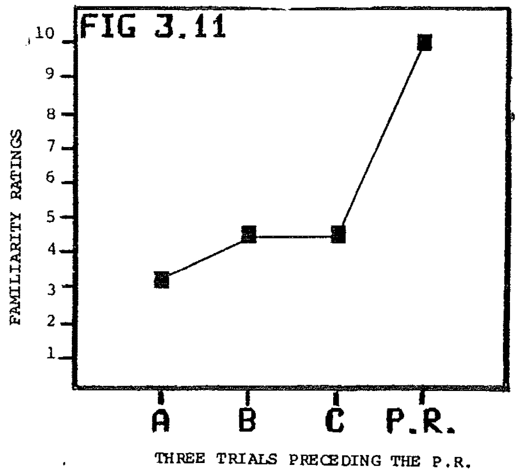
SUBJECT 7



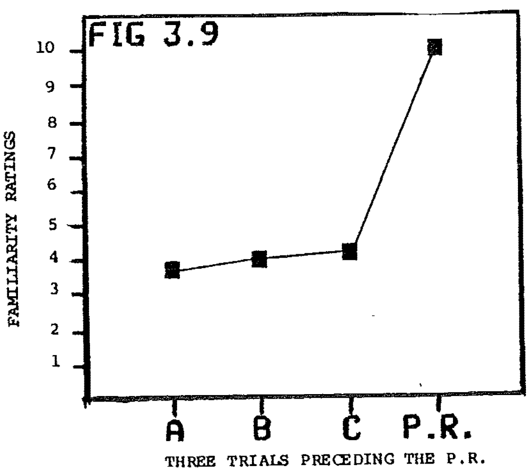
SUBJECT 10



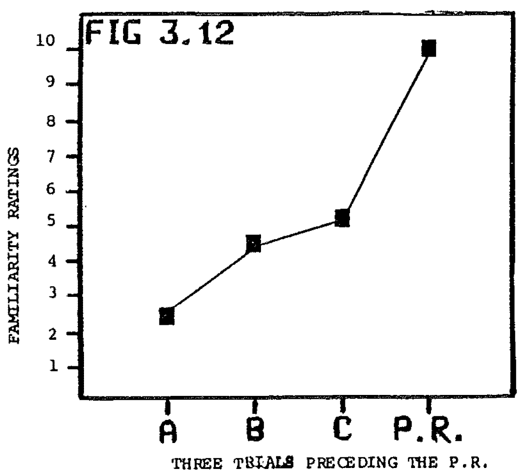
SUBJECT 8



SUBJECT 11



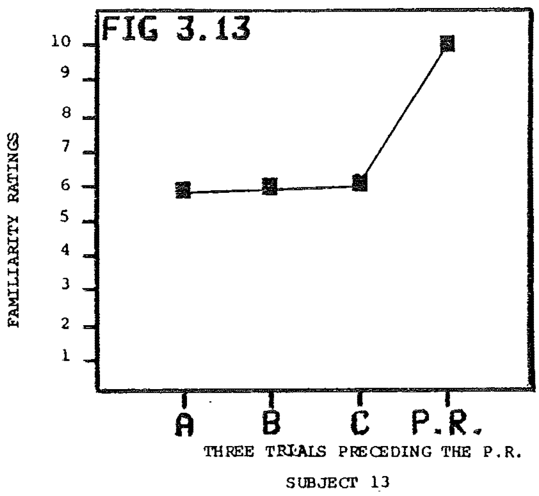
SUBJECT 9

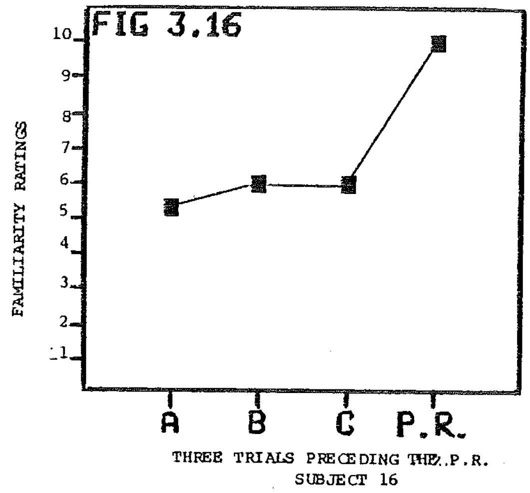


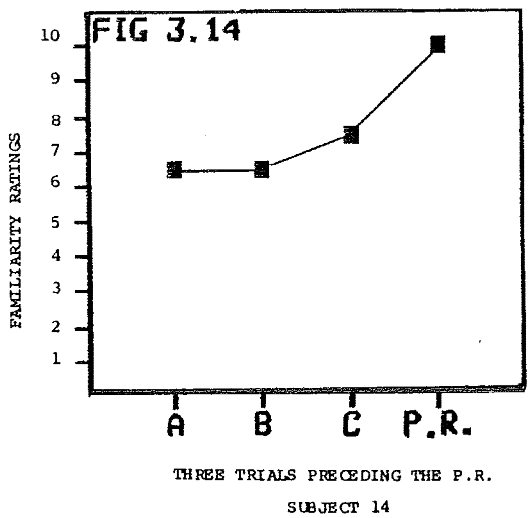
SUBJECT 12

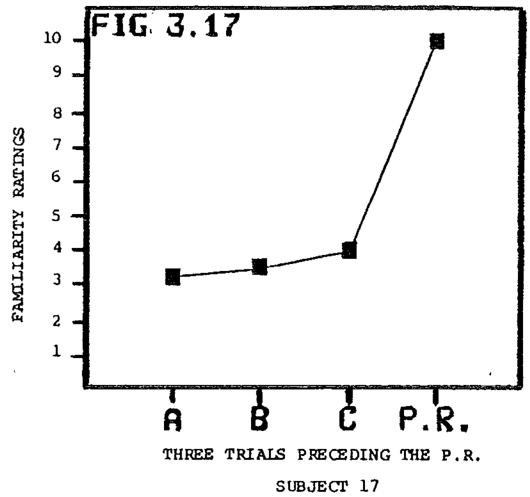
Figures 3-7 to 3-12

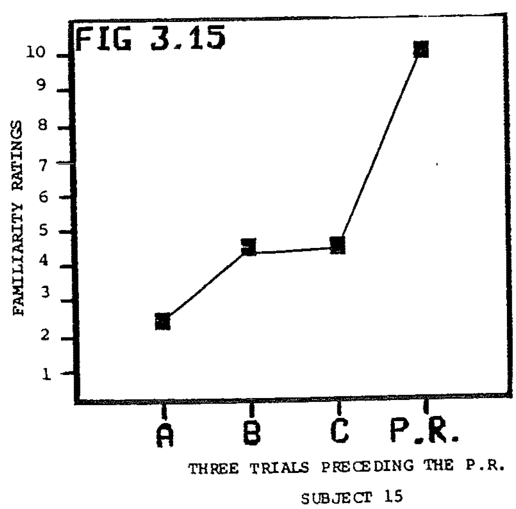
Mean Familiarity Ratings on the three trials preceding the Point of Recognition (P.R.) for Subjects 7 to 12.

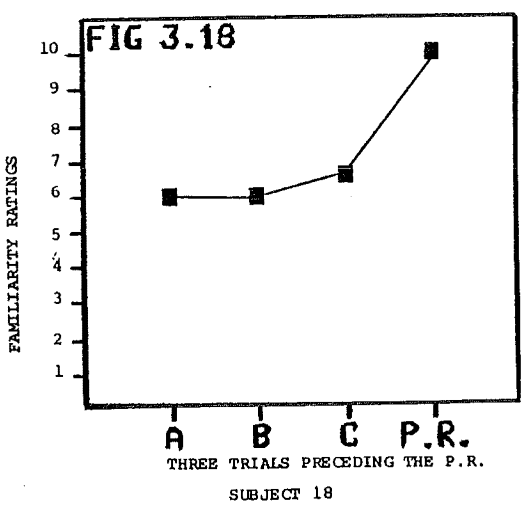






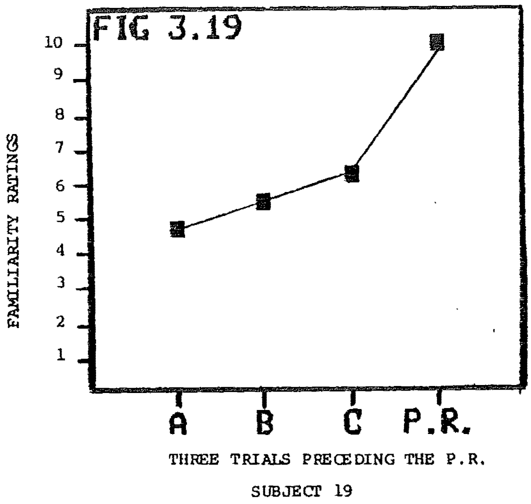


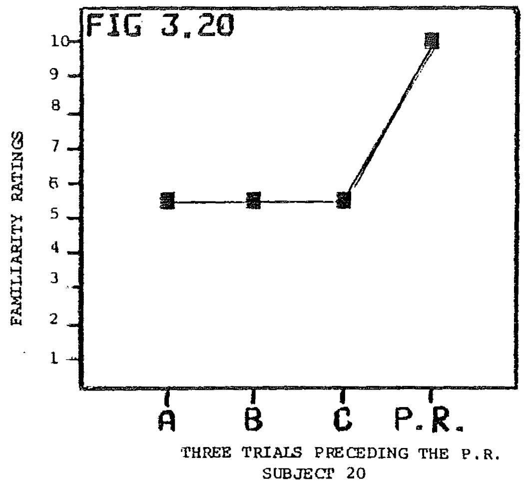




Figures 3-13 to 3-18

Mean Familiarity Ratings on the three trials preceding the Point of Recognition (P.R.) for Subjects 13 to 18.





Figures 3-19 and 3-20

Mean Familiarity Ratings on the three trials preceding the Point of Recognition (P.R.) for Subjects 19 and 20.

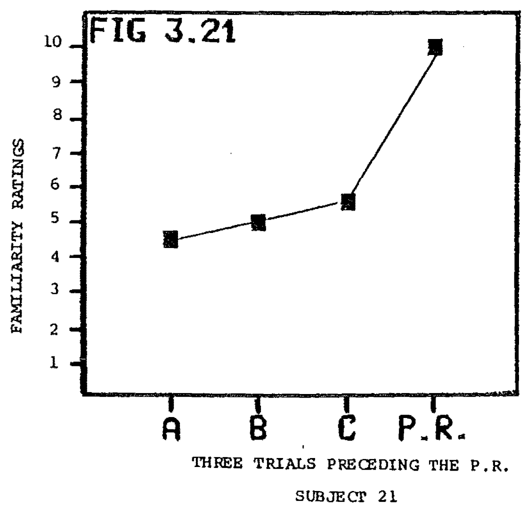


Figure 3-21

Mean Total Familiarity Ratings across all Subjects on the three trials preceding the Point of Recognition.

The total mean familiarity ratings on the three trials preceding the point of recognition, that is, between subjects and across all melodies are plotted in Figure 3-21 and presented in Table 3-5.

Table 3-5: Mean Familiarity Ratings on three trials prior to the point of recognition

	Preceding Trials			
	A	B	C	P.R
$\bar{X}$ TOT	4.52	5.01	5.66	(10)

A one way analysis of variance was performed upon these three mean familiarity ratings.

Table 3-6: ANOVA summary for total Mean Familiarity Ratings

Source	SS	df	MS	F	P
A	13.0217	2	6.5108	23.2315	.01
S	10.6499	38	0.2803		
A x S	125.0398	19	6.5810		

Therefore, the increasing familiarity ratings were significant at the 0.01 level.

A Tukey's Honestly Significant difference (HSD) was performed to determine which pairs of means in the familiarity ratings were significantly different.

Table 3-7: Table of means in each condition and the differences between means

Means	$\bar{X}_A$	$\bar{X}_B$	$\bar{X}_C$
$\bar{X}_A$	-	.49	1.14
$\bar{X}_B$	-	-	.65

HSD = 0.5267 with 59 degrees of freedom at $p < .01$. Thus, there is a significant difference between $\bar{X}_A$ and $\bar{X}_C$ and $\bar{X}_B$ and $\bar{X}_C$ at the 0.01 level. The difference between $\bar{X}_A$ and $\bar{X}_B$ is not significant. Thus, the data supports Hypothesis 1, and a TOT state can be induced by musical stimuli. It is characterized by an increasing preparedness of the subject to rate the melody as familiar on the three trials preceding the point of recognition.

4. HYPOTHESIS 2

The broad second hypothesis that partial recall of specific information will occur significantly before the point of recognition is analyzed in the following five separate hypotheses.

5. HYPOTHESIS 2.1

Firstly, Hypothesis 2.1 states that subjects will possess knowledge of the rhythm of the target melody prior to completely recalling the name of the target melody.

The frequencies of correct clapping of the rhythm of a melody were pooled across melodies and between subjects.

These frequencies were then paired with trials preceding the point of recognition.

Table 3-8: Frequencies of Correct Clapping on trials preceding the point of recognition

Trials preceding Point of Recognition	Frequencies	Pooled Frequencies across two trials
P.R	–	–
-1	13	22
-2	9	
-3	9	22
-4	13	
-5	13	18
-6	5	
-7	2	2
-8	0	

The table shows that as the subjects approached the point of recognition of the melodies, (Trial -8 to -1), the frequency of correct clapping increased. A one way Chi square showed χ^2 (df = 3, N = 64) = 17, $p < .001$. Therefore subjects were able to correctly clap the melody prior to the point of recognition.

Another statistical analysis was conducted on the data relevant to Hypothesis 2.1. One sample t-tests were conducted between subjects, comparing the mean trial on which correct clapping occurred with a theoretical mean of zero. The null hypothesis then, is that correct clapping will occur at the point of recognition (Trial zero). Trials preceding the point of recognition for this analysis were scored as negative deviations from zero, and represent the situation in which correct clapping occurs before the point of recognition. Thus ten t-tests were performed.

Table 3-9: t-tests for the ten test melodies

Melody	Mean P.R.	S.D.	df	t	p (Below see Key)
1	-2.789	2.829	18	4.182	***
2	-0.812	1.629	19	2.173	*
3	-1.1	1.415	19	3.388	**
4	-1.5	1.806	19	3.619	**
5	-1.276	1.711	18	3.165	**
6	-1.625	1.698	19	4.171	***
7	-1.431	1.751	17	3.367	**
8	-2.208	2.444	17	3.725	**
9	-1.184	2.657	18	1.891	N.S.
10	-3.488	1.68	19	9.05	***

Probability tests

* p .05
** p .01
*** p .001

Table 3-9 shows that all of the t-tests were significant except that for Melody 9. Therefore, we can conclude that subjects can generally clap correctly the rhythm of the extract prior to the point of recognition of the melody. It should be noted that multiple use of t-tests would be expected to increase the probability of obtaining significant results. Therefore, these analyses need to be interpreted cautiously.

6 HYPOTHESIS 2.2

Hypothesis 2.2 states that subjects will possess knowledge of a later melodic sequence in the target melody. This involves analysis of the data gained from the 'Snatch' task.

The frequencies of correct identification of the Snatch task were pooled across melodies and between subjects on each trial preceding the naming of the melody.

Table 3-10: Frequencies of Correct Identification of the Snatch task on trials preceding the point of recognition

Trials preceding Point of Recognition	Frequencies	Pooled Frequencies across two trials
P.R.	-	-
-1	18	28
-2	10	
-3	6	12
-4	6	
-5	1	4
-6	3	
-7	1	7
-8	6	
-9	4	4

The table shows that as the subjects approach the point of recognition, the frequency of correct identification of the snatch task increases. A one way Chi square showed

χ^2 (df = 4, N = 55) = 15.98, $p < .01$. While this result was not as highly significant as the previous findings, it does appear that subjects do possess knowledge of a later melodic sequence in a target melody.

7 HYPOTHESIS 2.3

Hypothesis 2.3 states that subjects will possess knowledge of the category of the melody prior to the point of recognition.

The frequencies of correct categorization of melodies were pooled across melodies and between subjects on each trial preceding the naming of the melody.

Table 3-11: Frequencies of Correct Categorization of Melodies on trials preceding the Point of Recognition

Trials preceding Point of Recognition	Frequencies	Pooled Frequencies across two trials
P.R.	-	-
-1	15	
-2	10	25
-3	3	
-4	1	4
-5	2	
-6	2	4
-7	0	
-8	0	0
-9	1	1

Table 3-11 shows that as the subjects approach the point of recognition, the frequency of correct categorization of melodies increases. A one way Chi square showed χ^2 (df = 4, N = 34)= 62.76, $p < .001$. Thus, subjects possess knowledge of the category of melodies prior to the point of recognition. A familiar example of this effect would be "I know it's a Christmas carol, but I can't think of its name ....."

8. HYPOTHESIS 2.4

Insufficient data were obtained to support Hypothesis 2.4, that subjects will be able to name similar sounding melodies to the target melody. The majority of subjects were unable to provide any information about similar sounding melodies to the target melodies (92% of subjects were unable to complete this task).

9. HYPOTHESIS 2.5

Insufficient data were obtained to support Hypothesis 2.5, that subjects will be able to name some of the words from the target melody (50% of the subjects were unable to complete this task).

10. HYPOTHESIS 3

Hypothesis 3 states that a systematic progression of occurrence of recalled information exists prior to the point of recognition. In order for this hypothesis to be supported it should be possible to establish a sequence of successful completions of the various tasks, which is similar across subjects. Five tasks were completed: clapping the rhythm of the melody, recognizing the Snatch, categorizing the target melody, naming any similar sounding melodies and naming some words from the target melody. It is only possible to use the data from the first three tasks as the last two did not provide enough information as noted previously. Therefore Table 3-12 presents the deviations from the point of recognition for the three tasks for each subject.

N.B. All the deviations are expressed as negative values, and thus the task with the largest negative value is the task which is completed first.

Table 3-12: Order of Successful Completion of Tasks within subjects

Subjects	Mean Successful Completion of Tasks		
	Clapping	Snatch	Category
1	-4	* -4.5	-2.5
2	-3.357	-1.57	-1.57
3	-3.5	-3.5	-2
4	-0.416	0	0
5	-1.625	-1	-0.375
6	-2.9	-1.9	0
7	-5.75	-4.375	-2.25
8	-1	-1	-0.2
9	-2.8	-1.3	-0.6
10	-3.0625	-1.625	-0.5

Table 3-12 (Continued)

Subjects	Mean Successful Completion of Tasks		
	Clapping	Snatch	Category
11	-2.44	-1.66	-0.22
12	-3	-1.7	-0.4
13	-1.72	-1.22	-0.11
14	-2.75	-1.5	-0.5
15	-2.9	-0.9	* -2
16	-3.83	-1.83	0
17	-5.08	-1.33	-1.16
18	-3.875	-2.375	-0.5
19	-3.625	-2	-1.5
20	-7	-3.25	* -4.5
	$\bar{X}$ = -3.232	$\bar{X}$ = -1.927	$\bar{X}$ = -1.6055

By ranking the order of completion of each of the tasks for each subject, it was found that clapping the rhythm was the first successfully completed task by 18 of the 20 subjects. Secondly, the Snatch task was the next task successfully completed by 17 of the 20 subjects. Finally, in third position, the category of the melody was correctly recalled by 18 of the 20 subjects. The asterisks in Table 3-12 indicate the exceptions to the general trend of successfully completing the clapping task, then the Snatch task and finally establishing the category of the target melody. It is also possible that the two tasks which were not included that is, naming any similar sounding melodies and naming any words in the target melody may occur at some later point in this sequence. However, the incompleteness of this data, reported earlier, precludes its inclusion in this analysis. This is the first time in the TOT literature that this aspect has been investigated, and may prove a worthwhile line of investigation for further research.

11. HYPOTHESIS 4

The fourth hypothesis states that subjects classified as musically experienced will perform significantly better on the partial recall of specific information than those classified as musically inexperienced.

In a simple frequency count of the number of melodies recognised by each group of subjects there was no difference.

Table 3-13: Frequency of Melodies recognized by musically inexperienced and musically experienced subjects

Condition	
Musically inexperienced	Musically experienced
51	51

The mean number of trials in which melodies were recognized was also calculated for the two conditions. The musically inexperienced condition required a mean of 4.436 trials to recognize the melodies, and the musically experienced condition required a mean of 5.145 trials to recognize the melodies. The significance of this difference was tested using an independent samples t test ($t = 0.912$, $df = 18$, N.S.)

There is not a significant difference between the mean number of trials required for recognition over the musically inexperienced and musically experienced conditions.

The effect of musical experience on susceptibility to the TOT state was also analyzed. Previous analyses indicated a monotonic increase in familiarity ratings three trials prior to the point of recognition as evidence of the TOT state. These data were further analyzed to determine the influence of the experential factor of musical experience.

The familiarity ratings three trials prior to the point of recognition were analyzed by a two way analysis of variance with repeated measures on one factor. The factors were Factor A, Musical experience (two levels) and Factor B, Familiarity Ratings (three levels, repeated measures).

Table 3-14: ANOVA summary of effects of musical experience on susceptibility to the TOT state

	Source	SS	df	MS	F	P
BETWEEN SUBJECTS	A	.3227	1	.3227	.0466	NS
	SUBJ. W.G.	124.7172	18	6.9287		
WITHIN SUBJECTS	B	13.0217	2	6.5109	23.9118	.01
	AB	.8476	2	.4238	1.5564	NS
	B X S.W.G.	9.8023	36	.2723		
	F MAX (SUBJ. W.G.)		= 2.5392		DF = 2,9	
	F MAX (B X SUBJ. W.G.)		= 1.2004		DF = 2,18	

The effect of Factor A, Musical experience was not significant. However, Factor B is significant at the 0.01 level. This confirms our earlier analyses that found increasing familiarity ratings as the point of recognition of a melody is approached. This is however a rather trivial finding in this analysis as the main interest was in the influence of Factor A, Musical experience. A non-significant interaction effect occurred. The F max statistics confirm that the data used in this Anova are homoscedastic.

Thus, we must reject Hypothesis 4; the factor of Musical experience did not produce a significantly better performance in the partial recall of specific information or produce a greater susceptibility to the TOT state.

12. HYPOTHESIS 5

The fifth hypothesis states that subjects assigned to a pre-listening condition, in which they hear a set of melodies will perform significantly better on recall and recognition measures than subjects assigned to a post-listening condition, who hear the melodies after the experimental session.

A binomial test was conducted to test whether or not there was a significant difference in the number of melodies recognized in the pre-listening condition as opposed to the post-listening condition. These data appear in the following table.

Table 3-15: Frequency of Melodies recognized by subjects in pre-listening and post-listening conditions

Condition	
Pre-listening	Post-listening
56	46

The difference is not significant ($z = .891$, $N = 102$, $p < .3$). Therefore, the addition of a pre-listening condition did not enable subjects to recognize more melodies, however, it may have enabled the subjects to recognize the melodies more quickly.

The mean number of trials taken for melodies to be recognized was also calculated. The subjects in the pre-listening condition required a mean of 5.97 trials and the subjects in the post-listening condition required a mean of 5.52 trials to recognize the melodies. ($t = 0.5001$, $df = 18$, NS). There is not a significant difference between the mean number of trials required for recognition over the pre-listening and post-listening conditions.

The effects of a pre-listening condition on susceptibility to a TOT state as compared to the effects of a post-listening condition were also analyzed. The familiarity ratings three trials prior to the point of recognition were analyzed by a two way analysis of variance with repeated measurers on Factor B. The factors were Factor A, Listening (two levels) and Factor B, Familiarity Ratings (three levels).

Table 3-16: ANOVA summary of effects of listening on susceptibility to the TOT state

	Source	SS	df	MS	F	P
BETWEEN SUBJECTS	A	1.2907	1	1.2907	.1877	NS
	SUBJ. W.G.	123.7491	18	6.875		
WITHIN SUBJECTS	B	13.0217	2	6.5109	22.9935	.01
	AB	.4561	2	.2280	.8053	NS
	B X S.W.G.	10.1938	36	.2832		

F MAX (SUBJ. W.G.) = 3.1494 DF = 2,9

F MAX (B X SUBJ. W.G.) = 1.8855 DF = 2,18

The effect of Factor A, Listening was not significant. However, Factor B is again significant at the 0.01 level. This again confirms our earlier findings that familiarity ratings increase as the point of recognition of a melody is approached. A non-significant interaction effect occurred. Again, the F max statistics confirm that the data used in this Anova are homoscedastic.

Thus, we must reject Hypothesis 5 and the inclusion of a pre-listening condition did not produce a significantly better performance nor a greater susceptibility to the TOT state.

CHAPTER IV

DISCUSSION AND CONCLUSIONS

The results presented in Chapter III provide support for many of the proposed hypotheses concerning the TOT state.

Firstly, the existence of a TOT state induced by musical stimuli is convincingly demonstrated. This is indicated by monotonically increasing familiarity ratings as the point of recognition of a melody is approached. This support for Hypothesis Number One is of key importance to the study as the other hypotheses depend upon the assumption that such a state does exist.

As mentioned in Chapter I, the occurrence of the TOT state with other types of stimuli has not been widely investigated. However, the finding of this study extends the research that has successfully demonstrated the existence of a TOT state using stimuli other than word definitions.

The second broad hypothesis that partial recall of specific types of information will occur significantly before the point of recognition of the target melody was investigated in five separate hypotheses. As said earlier, this was an attempt to translate Brown and McNeill's measures of partial recall in terms of the musical information available. The results show that the subjects do possess knowledge of a range of aspects of a melody before being able to name the melody.

More specifically, the subjects first possess knowledge of the rhythm of the melody. This is evidenced by the ability to clap the rhythm of the melody accurately. Secondly, the subjects possess knowledge of later parts of the same melody. This is evidenced by the ability to recognize an extract consisting of three notes, as belonging to that melody. Thirdly, the subjects are able to name the category or type of melody before being able to name the melody. Subjects were unable to name some of the words of the melody or to name any similar sounding melodies. Possibly these types of information may emerge simultaneously with or after the point of recognition of a melody. Alternatively, the poor performance of the subjects on these two tasks may be due to greater concentration upon the previous tasks as these were usually answered last.

The third hypothesis that a systematic progression of occurrence of recalled information exists prior to the point of recognition was supported. The sequence of the successful completions of the various tasks across melodies and between subjects shows a definite order. Subjects firstly clapped the rhythm of the melody accurately then recognized the Snatch task and finally categorized the target melody. Unfortunately the data from the two other tasks, naming some of the words of the melody and naming any similar sounding melodies could not be included. Surprisingly, this aspect of the TOT state has not been investigated in past research although it would seem to be an obvious consideration. It is certainly worthy of further investigation. Future research could also investigate other types of musical information that the subjects may possess before naming the melody. In this study, an attempt was made to determine the harmonic knowledge that the subjects possess about a melody. The 'Probe tone' task was developed for this purpose, however due to its difficulty, its use was discontinued.

Two underlying experential factors which may influence the occurrence of a TOT state were tested. Hypothesis Number Four concerned the influence of musical experience on performance in the tasks. No support was found for this hypothesis. Hypothesis Number Five concerned the influence of a pre-listening condition on performance in the tasks. Again, no support was found.

Therefore, this study using an exploratory approach has investigated the existence of a TOT state induced by musical stimuli which is analogous to the classic TOT state identified by Brown and McNeill. Many of the findings of Brown and McNeill have translated to the musical setting. A TOT state can be induced by musical stimuli and the subjects are able to recall a range of musical information before being able to name the melody. A unique finding is the systematic progression of occurrence of this recalled information between subjects and across melodies. As the primary emphasis in this study, has still been placed upon verbal information, it is impossible to distinguish the differences between the usual TOT state induced by word definitions and the TOT state induced by musical stimuli. In the introduction, a 'Tip of the Ear' (TOE) state was speculated upon. An investigation of this would most certainly identify the differences and similarities to the TOT state.

The validity of the findings of this study could be further enhanced through the addition of a control condition. This could be similar to Koriat and Lieblich's (1974) research where a 'Don't Know' category acts as a control condition. However, at the stage of designing this study, this work was unknown to the author.

This study was designed as an attempt to provide information on the TOT state induced by musical stimuli. To date, little research has been done in this field. However, this study has provided many positive findings and suggested further lines of investigation.

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APPENDIX A

COMPUTER PROGRAM

```
READY.

1 S=49152:GOSUB100:SYSS,C,L15:GOSUB20000
2 REM LOAD 'SYSOUND', DO DEMONSTRATION.
3 POKE53280,7:POKE53281,7:PRINT"{BLK}"
4 PRINT"{CLR}{C/DN}{C/DN}{C/RT}{C/RT} LYNLEY'S EXPERIMENT ":PRINT"{C/DN}{C/DN}"
5 PRINT"{BLK}NOTE: INSTRUCTIONS IN {RED}RED{BLK} ARE FOR S;    THOSE IN BLACK ARE FOR E."
6 PRINT"{BLK}TWENTY TUNES TO LOAD ":TN=20
7 PRINT"{C/DN}HIT 'Y' TO PLAY THE TUNES WHILE LOADING"
8 GETPL$:IFPL$=""THEN8
9 PRINT"{C/DN}{C/DN}LOADING THE ORIGINAL MELODIES."
10 DIMTU(20,25,1),TU%(25),TU$(20),KO(20)
11 DIMT(20),R(20):REM FOR BUBBLE SORT.
12 DIMSN(25):REM FOR RESCALED SNATCHES
15 FORK=1TOTN
20 READTU$(K),KO(K):REM NO. OF SEMITONES TO CONVERT TO KEY OF 'C'
22 FORNO=1TO25
25 READTU(K,NO,0):READTU(K,NO,1):REM READ LENGTHS AND NOTES.
40 NEXT NO
50 NEXTK
60 GOSUB200
62 PRINT"{CLR}{C/DN}{C/DN}HIT 'RETURN' WHEN YOU ARE READY TO ":PRINT"START THE EXPERIMENT."
63 INPUTYQ$
65 GOSUB250:REM PROBE CHORDS AND NOTES
99 END
100 REM SYSOUND - MARK STEED - 'COMPUTE!'
101 REM SEPT 1984.
102 DATA32,121,0,208,3,76,241,192,201,44,240,3,76,67,193,32,115,0
103 DATA162,9,221,76,193,240,6,202,16,248,76,67,193,138,10,170,189,85
104 DATA193,133,251,189,86,193,133,252,32,50,192,76,0,192,108,251,0,32
105 DATA55,193,201,1,144,4,201,4,144,3,76,72,193,202,142,114,193,96
106 DATA32,55,193,10,10,10,10,141,123,193,173,120,193,41,15,13,123,193
107 DATA141,120,193,96,32,55
108 DATA193,141,123,193,173,120,193,41,240,13,123,193,141,120,193,96,32,55
109 DATA193,10,10,10,10,141,123,193,173,121,193,41,15,13,123,193,141,121
110 DATA193,96,32,55,193,141,123,193,173,121,193,41,240,13,123,193,141,121
111 DATA193,96,32,115,0,162,3,221,103,193,240,6,202,16,248,76,67,193
112 DATA224,1,240,6,32,115,0,76,196,192,32,44,193,192,16,144,3,76
113 DATA72,193,142,117,193,140,118,193,162,1,189,107,193,141,119,193,96,32
114 DATA44,193,142,115,193,140,116,193,96,32,55,193,141,122,193,96,169,0
115 DATA162,24,157,0,212,202,16,250,169,0,141,115,193,141,116,193,76,115
116 DATA0,173,115,193,208,5,173,116,193,240,37,174,114,193,189,111,193,133
117 DATA251,169,212,133,252,160,6,185,115,193,145,251,136,16,248,160,4,173
118 DATA119,193,9,1,145,251,173,122,193,141,24,212,96,165,122,208,2,198
119 DATA123,198,122,76,121,0,32,166,173,32,247,183,166,20,164,21,96,32
120 DATA44,193,152,208,11,224,16,176,7,138,96,162,11,76,58,164,162,14
121 DATA208,249,86,65,68,83,82,87,70,76,67,53,192,72,192,94,192,112
122 DATA192,134,192,152,192,203,192,213,192,220,192,78,80,83,84,128,64,32
123 DATA16,0,7,14,0,0,0,0,0,0,0,0,0,0
124 FORI=49152TO49531:READJ:POKEI,J:K=K+J:NEXT
125 IFK<>44621THENPRINT"ERROR IN DATA STATEMENTS:STOP
126 RETURN
200 REM ADD SEMITONES TO CHANGE KEY TO KEY OF 'C'.
205 PRINT"{C/DN}{C/DN}CHANGING ALL TUNES TO KEY OF 'C'."
210 FORK=1TOTN:FORNO=1TO25
220 KC=2↑(KO(K)/12)
```

```
230 TU(K,NO,1)=TU(K,NO,1)*KC
237 IFPL$="Y"THENGOSUB8000:REM PLAY ALL TUNES
240 NEXT NO
245 NEXTK
249 RETURN
250 REM PLAY NOTES10-20, 9-20, 8-20...
255 PRINT"{BLK}{CLR}{C/DN}{C/DN}{C/RT}{C/RT}INCREMENTING FROM NOTE 10 TO NOTE 1"
256 PRINT:PRINT
262 FORK=1TO10:REM 10 TUNES
267 PRINT" ( TUNE";K;")"
270 FORD=10TO0STEP-1
272 PRINT"{BLK}STARTING AT NOTE";D
274 KEY=INT(RND(1)*5)+1:SH=2↑(KEY/12)
276 FORNO=1TO25:TU%(NO)=TU(K,NO,1)*SH:NEXTNO:REM RAISE 1 TO 5 SEMIT'S FROM 'C'
277 PRINT:PRINT"TUNE RAISED ";KEY;" SEMITONES"
278 T=TIME
279 FORNO=D TO 20
280 SYSS,V1,F(TU%(NO)),WS,A0,D9,S0,R0
282 T=T+5*TU(K,NO,0)
284 IFT>TIMEGOTO284
285 NEXTNO
286 PRINTTU%(1);"=FREQ OF NOTE 1 IN TUNE"
290 GOSUB9000
292 PRINT"{RED}PLEASE CLAP THE RHYTHM OF THE TUNE"
293 PRINT"{BLK}E HIT A KEY WHEN RHYTHM IS SCORED"
294 A$="":GETA$:IFA$=""THEN294
295 PRINT"{RED}PRESS A KEY WHEN VERBAL TASKS HAVE BEEN COMPLETED"
296 A$="":GETA$:IFA$=""THEN296
297 PRINT"{CLR}"
298 NEXTD:NEXTK
299 RETURN
300 REM DATA FOR FRERE JACQUES DEMO.
301 DATA4,2864,4,3215,4,3608,4,2864,4,2864,4,3215,4,3608,4,2864,4,3608,4,3823
302 DATA8,4291,4,3608,4,3823,8,4291,2,4291,2,4817,2,4291,2,3823,4,3608,4,2864
303 DATA2,4291,2,4817,2,4291,2,3823,4,3608,4,2864,4,2864,4,2145,8,2864,4,2864
304 DATA4,2145,8,2864
310 REM C = 2145 (C3), WHOLE NOTE = 4
311 DATAPOP GOES THE WEASEL,5
312 DATA4,3215,2,3215,4,3608,2,3608
313 DATA2,4050,2,4817,2,4050,4,3215,2,2408
314 DATA4,3215,2,3215,4,3608,2,3608
316 DATA6,4050,2,3215,2,0,2,2408
318 DATA4,3215,2,3215,4,3608,2,3608
320 DATA2,4050,2,4817,2,4050,4,3215
400 DATAGOOD KING WENCESLAS,4
402 DATA4,3406,4,3406,4,3406,4,3823
404 DATA4,3406,4,3406,8,2551
406 DATA4,2864,4,2551,4,2864,4,3215
408 DATA8,3406,8,3406
412 DATA4,3406,4,3406,4,3406,4,3823
414 DATA4,3406,4,3406,8,2551
416 DATA4,2864,4,2551,4,2864,4,3215
418 DATA8,3406
450 DATASILENT NIGHT,2
452 DATA3,2864,1,3215,2,2864,6,2408
454 DATA3,2864,1,3215,2,2864,6,2408
456 DATA4,4291,2,4291,6,3608
458 DATA4,3823,2,3823,6,2864
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460 DATA4,3215,2,3215,3,3823,1,3608,2,3215
462 DATA3,2864,1,3215,2,2864,6,2408
464 DATA4,3215,2,3215
480 DATATHE FIRST NOWELL,6
482 DATA1,3034,1,2703
484 DATA3,2408,1,2703,1,3034,1,3215
486 DATA4,3608,1,4050,1,4547
488 DATA2,4817,2,4547,2,4050
490 DATA6,3608
500 DATA1,4050,1,4547
502 DATA2,4817,2,4547,2,4050
504 DATA2,3608,2,4050,2,4547
506 DATA2,4817,2,3608,2,3215
508 DATA6,3034
515 DATAAMAZING GRACE,5
518 DATA2,2408,2,2703
520 DATA4,3215,2,4050,2,3215
522 DATA8,4050,4,3608
524 DATA8,3215,4,2703
526 DATA8,2408,2,2408,2,2703
528 DATA8,3215,2,4050,2,3215
530 DATA8,4050,4,3608
532 DATA20,4817,4,4050
534 DATA6,4817,2,4050,2,4817,2,4050
536 DATA8,3215,4,2408
538 DATATHE LORD'S MY SHEPHERD,7
540 DATA4,2145
542 DATA8,3608,3,3823,1,3215
544 DATA8,4291,2,3823,2,3215
546 DATA8,2864,4,3608
548 DATA4,3608,4,3215,4,3215
550 DATA8,4050,4,4050
552 DATA8,4291,4,3608
554 DATA4,3608,4,3823,4,3608
556 DATA8,3215,4,3608
558 DATA4,3823,4,4291,0,0,0,0
560 DATAAWAY IN A MANGER,5
562 DATA4,4817
564 DATA6,4817,2,4291,4,4050
566 DATA4,4050,4,3608,4,3215
568 DATA4,3215,4,3034,4,2703
570 DATA8,2408,4,2408
572 DATA6,2408,2,2703,4,2408
574 DATA4,2408,4,3608,4,3034
576 DATA4,2703,4,2408,4,3215
578 DATA8,4050,4, 4817
580 DATA6,4817,2,4291
582 DATAO LITTLE TOWN OF BETHLEHEM,5
584 DATA4,4050
586 DATA4,4050,4,4050,4,3823,4,4050
588 DATA4,4817,4,4291,4,2703,4,3608
590 DATA4,3215,2,3034,2,3215,4,3608,4,2408
592 DATA12,4050,4,4050
594 DATA4,4050,4,4050,4,5407,4,4817
596 DATA4,4817,4,4291,4,2703,4,3608
598 DATA4,3215
600 DATAO COME ALL YE FAITHFUL,5
602 DATA4,3215
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604 DATA8,3215,4,2408,4,3215
606 DATA8,3608,8,2408
608 DATA4,4050,4,3608,4,4050,4,4291
610 DATA8,4050,4,3608,4,3215
612 DATA8,3215,4,3034,4,2703
614 DATA4,3034,4,3215,4,3608,4,4050
616 DATA8,3034,6,2703,2,2408
618 DATA12,3034
620 DATA8,4817
630 DATARULE BRITANNIA,4
632 DATA8,4291,4,0,4,4291
634 DATA4,4547,4,4547,4,0,4,4291
636 DATA4,4547,4,4291,4,3823,4,3406
638 DATA12,3215,4,0
640 DATA8,5103,8,4547
642 DATA2,4291,2,3406,2,4547,2,3823,4,5103,4,4547
644 DATA8,4291,8,3823
646 DATA12,3406,4,0
700 DATA AULD LANG SYNE,10
702 DATA 4,3608,6,4817,2,4817,4,4817,4,6069,6,5407,2,4817,4,5407,4,6069
704 DATA6,4817,2,4817,4,6069,4,7217,12,8101,4,8101
706 DATA6,7217,2,6069,4,6069,4,4817,6,5407,2,4817,4,5407,2,6069,2,5407,6,4817
708 DATA HOME ON THE RANGE,5
710 DATA4,2408,4,2408,4,3215,4,3608,8,4050,2,3215,2,3034,4,2703,4,4291,4,4291
712 DATA8,4291,2,4291,2,4291,8,4817,2,3215,2,3215,4,3215,4,3034,4,3215,20,3608
714 DATA4,2408,4,2408,4,3215,4,3608,8,4050
716 DATA MY BONNIE LIES OVER THE OCEAN,5
718 DATA4,2408,6,4050,2,3608,4,3215,4,3608,4,3215,4,2703,4,2408,16,2025,4,2408
720 DATA6,4050,2,3608,4,3215,4,3215,4,3034,4,3215,20,3608,4,2408
722 DATA6,4050,2,3608,4,3215,4,3608,4,3215,4,2703,4,2408
724 DATA MOON RIVER,0
726 DATA12,3215,4,4817,8,4291,6,4050,2,3608,2,3215,2,2864,8,3215,4,2145
728 DATA6,4050,2,3608,2,3215,2,2864,8,3215,4,2145,20,2408,4,2703,12,2145
730 DATA4,3215,6,2703,2,2408,12,2145,4,3215,6,2703,2,2408
732 DATA LOVE ME TENDER,5
734 DATA4,2408,4,3215,4,3034,4,3215,4,3608,4,2703,8,3608,4,3215,4,3034,4,2703
736 DATA4,3034,16,3215,4,2408,4,3215,4,3034,4,3215,4,3608,4,2703,8,3608
738 DATA4,3215,4,3034,4,2703,4,3037,16,3215,4,0
740 DATA HEY JUDE,7
742 DATA4,4291,10,3608,2,3608,2,4291,2,4817,8,3215,4,0,2,3215,2,3608,4,3823
744 DATA6,5728,2,5728,2,5407,2,4291,2,4817,1,4291,1,3823,8,3608,4,4291
746 DATA2,4817,4,4817,2,4817,2,6430,2,5728,1,5407
748 DATA RAINDROPS KEEP FALLING ON MY HEAD,7
750 DATA4,3608,2,3608,2,3608,2,3823,2,3608,2,3215,2,2864,12,3608,4,0
752 DATA4,4291,2,4291,2,4291,2,4817,2,4291,2,3823,2,3608,4,3608,4,3823
754 DATA4,3215,4,2864,8,5407,2,4817,2,4291,2,3608,2,2703
756 DATA GOD SAVE THE QUEEN,5
758 DATA4,3215,4,3215,4,3608,6,3034,2,3215,4,3608,4,4050,4,4050,4,4291,6,4050
760 DATA2,3608,4,3215,4,3608,4,3215,4,3034,12,3215,4,4817,4,4817,4,4817
762 DATA 6,4817,2,4291,4,4050,4,4291,4,4291,4,4291
764 DATA YANKEE DOODLE,0
766 DATA4,4291,4,4291,4,4817,4,5407,4,4291,4,5407,8,4817,4,4291,4,4291,4,4817
768 DATA4,5407,8,4291,8,4050,4,4291,4,4291,4,4817,4,5407,4,5728,4,5407,4,4817
770 DATA4,4291,4,4050,4,3215,4,3608,4,4050
772 DATA TWINKLE TWINKLE LITTLE STAR,10
774 DATA4,2408,4,2408,4,3608,4,3608,4,4050,4,4050,8,3608,4,3215,4,3215,4,3034
776 DATA4,3034,4,2703,4,2703,8,2408,4,3608,4,3608,4,3215,4,3215,4,3034,4,3034
778 DATA8,2703,4,3608,4,3608,4,3215,4,3215
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780 DATA BAA BAA BLACK SHEEP,0
782 DATA4,2145,4,2145,4,3215,4,3215,2,3608,2,3608,2,3608,2,3608,8,3215,4,2864
784 DATA4,2864,4,2703,4,2703,4,2408,4,2408,8,2145,4,2145,2,2145,2,2145,4,3215
786 DATA4,3215,4,3608,2,3608,2,3608,6,3215
788 DATA OLD MACDONALD HAD A FARM,5
790 DATA4,3215,4,3215,4,3215,4,2408,4,2703,4,2703,8,2408,4,4050,4,4050
792 DATA4,3608,4,3608,8,3215,4,0,4,2408,4,3215,4,3215,4,3215,4,2408,4,2703
794 DATA4,2703,8,2408,4,4050,4,4050,4,3608,4,3608
796 DATA SING A SONG OF SIXPENCE,0
798 DATA2,3215,2,3608,2,3215,2,2703,4,2145,2,4291,2,4291,2,4050,2,4050,2,2408
800 DATA2,2703,8,2864,2,2864,2,3215,2,2864,2,2408,4,2025,4,3608,4,3215,2,2145
802 DATA2,2408,8,2703,2,3215,2,3608,2,3215
8000 T=TIME
8002 SYSS,V1,F(TU(K,NO,1)),WS,A0,D9,S0,R0
8004 T=T+5*TU(K,NO,0)
8006 IFT>TIMEGOTO8006
8010 RETURN
9000 REM PROBE CHORDS & SNATCHES.
9001 REM PLAY A RANDOM MAJOR CHORD SCALED FROM 'C' UPWARDS, OR A SNATCH.
9002 Q=5:REM 5 CHORDS
9003 GOSUB10000:REM GET 'Q' RANDOM NO'S
9004 A$="":KR=INT(RND(1)*20)+1:REM CHOOSE A DIFFERENT SNATCH.
9005 IFKR=KTHEN9004:REM MAKE SURE ITS A DIFFERENT TUNE FROM THE TARGET
9007 FORCH=1TOQ
9008 PRINT"{RED}HIT ANY KEY TO HEAR PROBE  "
9009 A$="":GETA$:IFA$=""THEN9009
9010 E%=2703:G%=3215:C%=4291
9018 SH=2↑(R(CH)/12):E%=E%*SH:G%=G%*SH:C%=C%*SH
9020 SYSS,V1,F(E%),WS,A0,D9,S0,R0
9030 SYSS,V2,F(G%),WS,A0,D9,S0,R0
9040 SYSS,V3,F(C%),WS,A0,D9,S0,R0
9055 PRINT"{BLK}CHORD RAISED ";R(CH);" SEMITONES"
9056 PRINTC%;"=FREQ OF C IN CHORD"
9060 NEXTCH
9100 REM:PLAY 5-NOTE SNATCH
9101 PRINT"{RED}LISTEN TO THIS SEQUENCE:":FORDE=1TO2000:NEXTDE
9102 RT=RND(1):IFRT>.5THEN9155
9105 T=TIME:REM SNATCH FROM SAME TUNE
9110 FORNO=21TO25
9115 SN(NO)=TU(K,NO,1)*SH:REM RESCALE SNATCH TO MATCH TARGET TUNE
9120 SYSS,V1,F(SN(NO)),WS,A0,D9,S0,R0
9130 T=T+5*TU(K,NO,0)
9140 IFT>TIMEGOTO9140
9145 NEXTNO
9150 INPUT"IS THIS SEQUENCE PART OF THE TUNE (Y/N)";SQ$
9151 PRINT"{BLK}IT IS FROM THE SAME TUNE."
9152 RETURN
9155 REM PLAY SNATCH FROM A DIFFERENT TUNE
9157 T=TIME
9160 FORNO=21TO25
9165 SN(NO)=TU(KR,NO,1)*SH:REM RESCALE SNATCH TO MATCH TARGET
9170 SYSS,V1,F(SN(NO)),WS,A0,D9,S0,R0
9180 T=T+5*TU(KR,NO,0)
9190 IFT>TIMEGOTO9190
9195 NEXTNO
9196 INPUT"{RED}IS THIS SEQUENCE PART OF THE TUNE (Y/N)";SQ$
9197 PRINT"{BLK}IT IS FROM A DIFFERENT TUNE."
9199 RETURN
10000 REM BUBBLE SORT FOR Q RANDOM INTEGERS, STARTING AT ONE.
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10010 FORB=1TOQ:T(B)=0:R(B)=0:NEXTB
10020 FORB=1TOQ
10030 X=INT(RND(1)*Q)+1
10040 IFT(X)=1THEN10030
10050 T(X)=1:R(B)=X
10060 NEXTB
10070 RETURN
20000 REM PLAY FRERE JACQUES DEMO....
20001 DIMLD(32),ND(32):POKE53280,8:POKE53281,8:PRINT"{BLK}"
20002 PRINT"{CLR}DEMONSTRATION:":PRINT
20003 GOSUB20500
20004 T=TIME:FORK=1TO32:READLD(K),ND(K)
20005 SYSS,V1,F(ND(K)),WS,A0,D9,S0,R0
20006 T=T+5*LD(K)
20008 IFT>TIMEGOTO20008
20010 NEXTK
20011 PRINT:PRINT"{WHT}HIT ANY GEY WHEN READY{BLK}"
20012 GETA$:IFA$=""THEN20012
20014 PRINT"{CLR}FOR EXAMPLE:"
20015 T=TIME:FORK=10TO20
20016 SYSS,V1,F(ND(K)),WS,A0,D9,S0,R0
20017 T=T+5*LD(K)
20018 IFT>TIMEGOTO20018
20019 NEXTK:FORD=1TO500:NEXTD
20020 E%=2703:G%=3215:C%=4291:FORK=1TO5
20021 SH=2↑(K/12):E1%=E%*SH:G1%=G%*SH:C1%=C%*SH
20022 SYSS,V1,F(E1%),WS,A0,D9,S0,R0
20023 SYSS,V2,F(G1%),WS,A0,D9,S0,R0
20024 SYSS,V3,F(C1%),WS,A0,D9,S0,R0
20025 FORD=1TO500:NEXTD,K
20030 PRINT"{CLR}THE NEXT TASK IS TO DECIDE WHETHER"
20032 PRINT"OR NOT A BRIEF SELECTION OF NOTES THAT"
20033 PRINT"IS PLAYED IS PART OF THE TUNE OR NOT."
20034 FORD=1TO1500:NEXTD
20036 SYSS,F(2864):FORD=1TO400:NEXT
20037 SYSS,F(2864):FORD=1TO400:NEXT
20038 SYSS,F(2145):FORD=1TO800:NEXT
20039 SYSS,F(2864):FORD=1TO400:NEXT:SYSS,F(2864):FORD=1TO400:NEXT
20040 PRINT:PRINT"HIT ANY KEY WHEN READY"
20045 GETA$:IFA$=""THEN20045
20046 PRINT"{CLR}FINALLY, YOU WILL BE ASKED A NUMBER OF"
20047 PRINT"QUESTIONS ABOUT THE TARGET TUNE."
20048 PRINT"YOUR RESPONSES WILL BE RECORDED BY THE  EXPERIMENTER."
20049 PRINT"HIT 'RETURN' TO CONTINUE:":INPUTYX$
20099 RETURN
20500 REM - INSTRUCTIONS GO IN HERE
20502 PRINT"WE TAKE THE FIRST 20 NOTES OF A TUNE,"
20503 PRINT"AND PLAY NOTES 10 TO 20, 9 TO 20,"
20504 PRINT"8 TO 20, AND SO ON, UNTIL YOU RECOGNISE THE TUNE."
20506 PRINT"AFTER EACH PIECE OF THE TUNE IS PLAYED"
20508 PRINT"YOU WILL BE ASKED A NUMBER OF QUESTIONS"
20510 PRINT"ABOUT THE TUNE."
20512 PRINT:PRINT"AFTER THE FRAGMENT OF THE TUNE HAS"
20514 PRINT"BEEN PLAYED, 5 CHORDS WILL SOUND."
20516 PRINT"YOUR FIRST TASK IS TO CHOOSE WHICH ONE"
20517 PRINT"OF THESE CHORDS WOULD BE THE FINAL "
20520 PRINT"CHORD THAT WOULD END THE TUNE."
20599 RETURN
```

APPENDIX B

TASK SHEET

SUBJECT . . . .

TUNE . . . .

INSTRUCTIONS

This experiment involves listening to a number of familiar tunes. We take the first 20 notes of a melody and play notes 10 to 20, 9 to 20, 8 to 20 and so on, until you recognise the tune.

After listening to the fragment of the tune, please answer the questions in the appropriate place. The tester will indicate to you which trial you are doing.

Attempt to answer all the questions unless otherwise instructed, whether you know the melody or not.

N.B. If at any stage while answering the questions, you can name the tune, write the name of the tune on your sheet and the question you were answering at the time.

QUESTIONS:

1. Clap the rhythm of the tune you have just heard.

2. A brief selection of notes will be played. Decide whether or not these form a later part of the same tune.

   Trial 1: YES / NO

   Trial 2: YES / NO

   Trial 3: YES / NO

   Trial 4: YES / NO

   Trial 5: YES / NO

   Trial 6: YES / NO

   Trial 7: YES / NO

   Trial 8: YES / NO

   Trial 9: YES / NO

   Trial 10: YES / NO

Page 2 SUBJECT . . . .

TUNE . . . .

3. Did you know the name of the tune you just heard? If YES, write the name of the tune below:

Trial 1:

Trial 2:

Trial 3:

Trial 4:

Trial 5:

Trial 6:

Trial 7:

Trial 8:

Trial 9:

Trial 10:

4. Rate the familiarity you have with the melody you just heard according to the following scale. Write the scale number below.

1	2	3	4	5	6	7	8	9	10
Never heard it before		Vaguely familiar		Sure I have heard it before			Know it but I can't name it		Know it

Trial 1:

Trial 2:

Trial 3:

Trial 4:

Trial 5:

Trial 6:

Trial 7:

Trial 8:

Trial 9:

Trial 10:

Page 3

SUBJECT . . . .

TUNE . . . .

5. Can you choose a general category for the melody from the following. If YES select from the following categories and write the appropriate capital letter below.

A Hymn

B British Folksong

C Nursery Rhyme

D Christmas Carol

E American Folksong

F Patriotic Song

G Pop Song

H Other

Trial 1:

Trial 2:

Trial 3:

Trial 4:

Trial 5:

Trial 6:

Trial 7:

Trial 8:

Trial 9:

Trial 10:

Page 4

SUBJECT . . . . . .

TUNE . . . .

6. Can you suggest or name a similar sounding tune? If YES, write the name of that tune below as well.

Trial 1:

Trial 2:

Trial 3:

Trial 4:

Trial 5:

Trial 6:

Trial 7:

Trial 8:

Trial 9:

Trial 10:

7. Can you name any of the words in the melody? If YES, please write them down here.

Trial 1:

Trial 2:

Trial 3:

Trial 4:

Trial 5:

Trial 6:

Trial 7:

Trial 8:

Trial 9:

Trial 10:

APPENDIX C

TAPE ANSWER SHEET

SUBJECT . . . .

You will hear a tape of a set of tunes. After listening to the set of tunes, put a tick beside those tunes which you heard.

( ) YANKEE DOODLE
( ) AULD LANG SYNE
( ) THE FIRST NOWELL
( ) CLOSE TO YOU
( ) POP GOES THE WEASEL
( ) O COME ALL YE FAITHFUL
( ) THE LORD'S MY SHEPHERD
( ) BELLS OF ST CLEMENTS
( ) GOD SAVE THE QUEEN
( ) FRERE JACQUES
( ) HOME ON THE RANGE
( ) SILENT NIGHT
( ) HUMPTY DUMPTY
( ) MOON RIVER
( ) RULE BRITANNIA
( ) DEEP PURPLE
( ) AWAY IN A MANGER
( ) WHERE HAVE ALL THE FLOWERS GONE?
( ) GOD DEFEND NEW ZEALAND
( ) MY BONNIE LIES OVER THE OCEAN
( ) LOVE ME TENDER
( ) MORNINGTON RIDE
( ) BAA BAA BLACK SHEEP
( ) O LITTLE TOWN OF BETHLEHEM
( ) PRAISE TO THE LORD, THE ALMIGHTY
( ) JINGLE BELLS
( ) YESTERDAY
( ) ONCE IN ROYAL DAVID'S CITY
( ) MICHAEL, ROW THE BOAT ASHORE
( ) RAINDROPS KEEP FALLING ON MY HEAD
( ) SCARBOROUGH FAIR

( ) TWINKLE, TWINKLE LITTLE STAR

( ) GOOD KING WENCELAS

( ) AMAZING GRACE

( ) SING A SONG OF SIXPENCE

( ) OLD MACDONALD HAD A FARM

( ) HEY JUDE

( ) HAPPY BIRTHDAY

( ) WALTZING MATILDA

( ) PRAISE MY SOUL

APPENDIX D

MUSICAL EXPERIENCE AND AVAILABILITY FOR TESTING QUESTIONNAIRE

PLEASE FILL IN THE FOLLOWING INFORMATION

1 NAME . . . .

2 ADDRESS . . . .

. . . .

3 TELEPHONE NUMBER . . . .

4 SEX: MALE/FEMALE

5 Have you ever studied music on a regular and individual basis? YES/NO

6 If YES, please specify the following information:

Years (From/To)	Instrument/ Specialization	Formal Tuition/ Self Taught	Performance/ Theoretical Study	Average Number of hours Study/ Was

7 Have you studied Music on a Group basis? YES/NO

8 If YES, please specify the following information:

Years (From/To)	Type of Experience	Average Number of Hours Study per week

9 What possible times are you available for Testing?

MONDAY:
TUESDAY
WEDNESDAY:
THURSDAY:
FRIDAY:

THANK YOU FOR YOUR ASSISTANCE

Lynley Sinclair
Telephone: 843 969

Experimental Setting